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PROCEEDINGS OF ANIMAL WASTE MANAGEMENT CONFERENCE HELD IN KANSAS CITY, MISSOURI ON FEBRUARY 20, 1969

Federal Water Pollution Control Administration
Kansas City, Missouri

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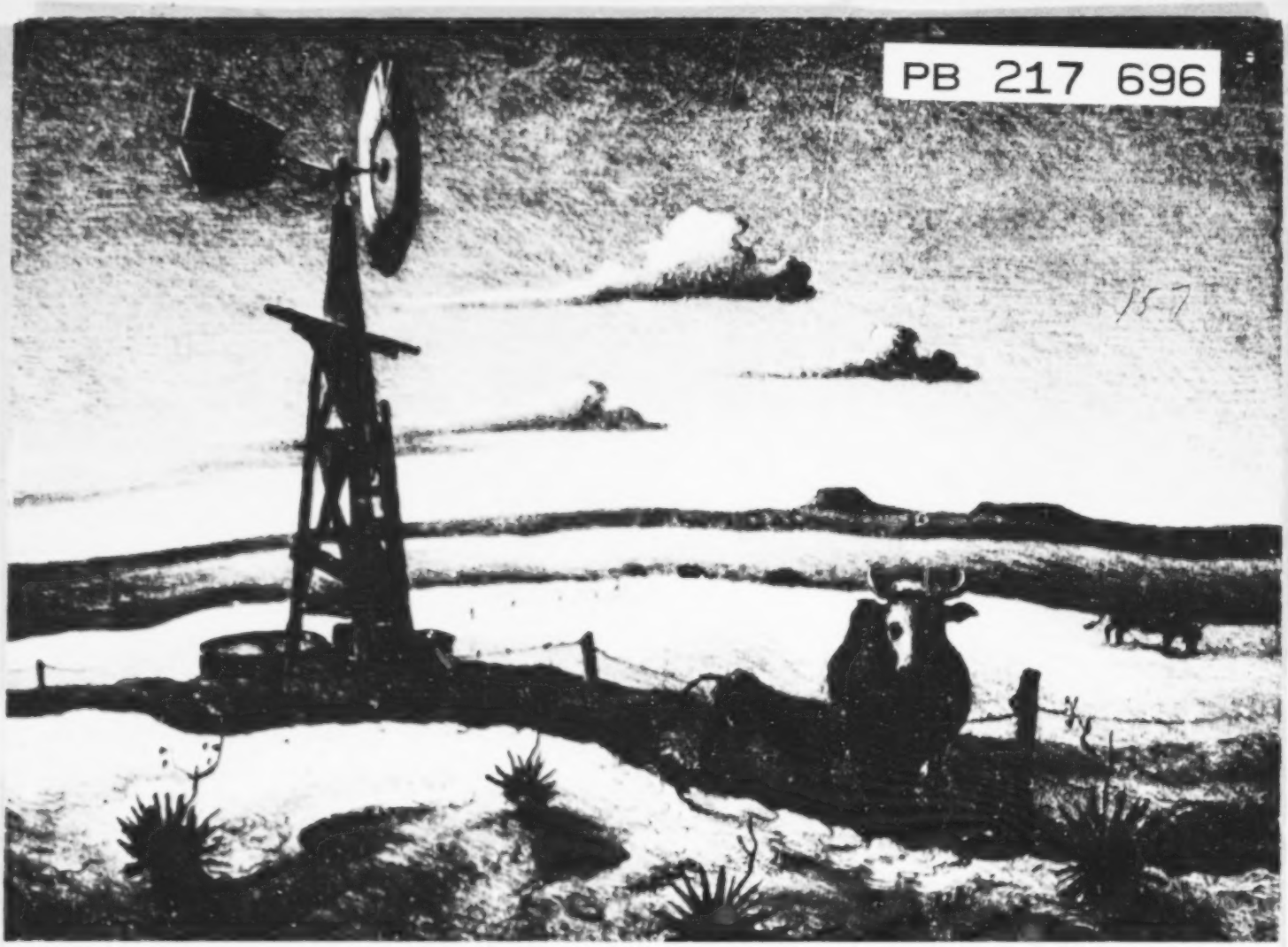

WEST TEXAS — THOMAS HART BENTON

PROCEEDINGS OF

Animal Waste Management Conference

U. S. DEPARTMENT OF THE INTERIOR

Federal Water Pollution Control Administration

MISSOURI BASIN REGION

KANSAS CITY, MISSOURI

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FEBRUARY, 1969

The implementation of effective programs for abating animal waste pollution is dependent on an integrated, cooperative approach by industry, researchers, and regulatory agencies. The enormity and diversity of the problem requires an interdisciplinary approach in which all relevant factors receive consideration.

Leaders from all segments of society have joined together to attack this grave environmental problem. We are pleased to coordinate the activities of these distinguished individuals. The task groups will help establish a consensus for action — moving from verbal commitment of principle to meaningful control action. We owe a tremendous debt of gratitude for their continuing efforts to solve the problem of animal waste pollution.

Animal Waste Management

PILOT (STEERING) TASK GROUP

1. Dr. Allan Hirsch	Acting Assistant Commissioner for Operations, FWPCA
2. Mr. Bill House	President, American National Cattlemen's Association
3. Dr. Ross McKinney	Parker Professor, University of Kansas
4. Mr. Keith Myers	Chairman, MBIAC - Nebraska State Conservationist
5. Mr. Vern Nelson	Nelson, Haley, Patterson and Quirk Engineering Consultants, Greeley, Colorado
6. Mr. John M. Rademacher	Director, Missouri Basin Region, FWPCA
7. Mr. Anthony Resnik	Sanitary Engineer, Missouri Basin Region, FWPCA, (Secretary to Task Group)
8. Mr. Cordell Tindall	Chairman, Missouri Governor's Council on Agriculture Committee
9. Chairman - Inventory Task Group	To be named
10. Chairman - Development Task Group	To be named
11. Chairman - Research Task Group	To be named

CONTROL TASK GROUP

1. Mr. Herb Albers
   Nebraska Feeders Association, Advisory Committee Member to State Water Pollution Control Council
2. Mr. John Badalich
   Director, Minnesota Pollution Control Agency
3. Mr. Eldon Butler
   Head, Engineering and Watershed Planning Unit, S.C.S. - USDA
4. Mr. Floyd L. Matthew
   Professor, The South Dakota School of Mines and Technology
5. Mr. J. Lee Mayes
   Director, Environmental Health Services, Kansas State Department of Health
6. Mr. Frank Rozich
   Director, Colorado Water Pollution Control Division, Colorado Department of Public Health
7. Mr. Lee Schuster
   Schuster Farms, Gower, Missouri
8. Mr. Harold Snider
   Feedlot Operator, Ray County, Missouri
9. Mr. Arthur E. Williamson
   Director, Division of Enviromental Sanitation, Wyoming Department of Public Health

INVENTORY TASK GROUP

1. Mr. C. W. Brinck
   Director, Division of Environmental Sanitation, Montana State Board of Health
2. Mr. Charles Carl
   Director, Division of Sanitary Engineering, South Dakota State Department of Health
3. Mr. T. A. Filipi
   Executive Secretary, Nebraska Water Pollution Control Council
4. Mr. Allan Fisk
   Assistant State Conservationist (Nebraska) S.C.S. - USDA
5. Mr. Bill Krejci
   Co-chairman Legislative Committee, Nebraska Livestock Feeders Association
6. Dr. Coy McNabb
   Professor of Agricultural Economics, Extension Economist, University of Missouri
7. Mr. Norman L. Peterson
   Director, Division of Water Supply and Pollution Control, North Dakota State Department of Health
8. Mr. R. J. Schliekelman
   Technical Secretary, Iowa Water Pollution Control Commission, Des Moines, Iowa
9. Mr. Jack K. Smith
   Executive Secretary, Missouri Water Pollution Board

RESEARCH TASK GROUP

1. Mr. Hal Bernard
   Chief, Agricultural and Marine Pollution Control Branch, FWPCA
2. Dr. Chester E. Evans
   Branch Chief, United States Department of Agriculture, ARS, Fort Collins, Colorado
3. Dr. Jack Gakstatter
   Iowa State Hygienic Laboratory
4. Dr. William Garner
   Midwest Research Institute, Kansas City, Missouri
5. Mrs. Janet L. C. Rapp
   Director of Laboratories, Feed Service Corporation, Crete, Nebraska
6. Dr. Lawrence A. Schmid
   Professor, Department of Civil Engineering, Kansas State University
7. Dr. George Smith
   Director, Missouri Water Resources Institute, Columbia, Missouri
8. Dr. Gene Vandergriff
   Midwest Research Institute, Kansas City, Missouri
9. Dr. John Ward
   Professor, Civil Engineering, Colorado State University
10. Mr. Marvin Wood
    Director, Robert S. Kerr Water Quality Laboratory, Ada, Oklahoma

FOREWORD

America has been abundantly blessed with fertile agricultural lands - producing foods for an ever increasing affluent society. In this land of agricultural supremacy therein grows a dichotomy - while production benefits have doubled during the past decade - the unsolved animal waste problems are proliferating in a manner unprecedented in history.

We are harnessing and treating our municipal wastes - often to the point of reuse of the waters. But we have not yet made adequate provision to shackle the water pollution emanating from animal wastes. In a land as generously endowed with technology as ours, it is time for action. We must now make provision to control animal waste pollution to protect and enhance the industry - agriculture - that has made this a great nation.

The challenge before us is largely one of adaptation - that of adapting to a soaring population (man and animal), and that of conforming to society's desire to preserve the quality of our environment.

The Federal Water Pollution Control Administration, Missouri Basin Region, is proud to have conducted the Animal Waste Management Conference in Kansas City, Missouri, February 20, 1969. We gratefully acknowledge the full cooperation of the U.S. Department of Agriculture, The Federal Water Pollution Control Administration's Robert S. Kerr Water Research Center, the Livestock Industry and the Missouri River Basin States. Our sincere gratitude is also extended to the program participants who served without compensation. In the final analysis it is they who are truly responsible for the success of the Conference.

The problem demands all the professional resources and all the enlightened participation and support of the people we can muster. It has been gratifying to see so many segments represented at the Conference. More than 200 individuals from 24 States and the District of Columbia attended the meetings.

It is our hope that the proceedings of the Conference with be helpful to the many persons interested in animal waste management.

John M. Rademacher

JOHN M. RADEMACHER
Director
Missouri Basin Region
Federal Water Pollution
Control Administration
U.S. Department of the Interior

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INDUSTRY AND THE ENVIRONMENT
FEEDLOT WASTE MANAGEMENT

Hon. Bill Clayton, Representative
Texas State Legislature

Today, more so than at any other time in our Nation's history, we have become alerted to the significance of the various threats to our water and air resources and to our environment in general. Every day, the news media carry stories of various abuses to our environment. Occasionally, certain instances achieve national prominence, such as the recent Santa Barbara oil slicks. All this publicity has, as you would expect, caused a general awareness of the problem which has given birth to a healthy degree of pub'ic concern. It has also caused the growth of an attitude which is providing a maximum amount of heat and a minimal amount of light on the pollution issue.

In a recent newspaper article, I came across an item which evidenced the positive side of the ledger - the beneficial aspect of public recognition of the pollution problem. The article commented on a New York Congressman who had sent questionnaires to all of the constituents of his Congressional District and sought their opinions regarding various budgetary considerations before the Congress. More voters expressed opposition to cuts in federal expenditures for the abatement of air and water pollution than for any other program. Of the more than 30,000 people responding to the questionnaire, 86% were opposed to cutting the $358 million appropriation for anti-pollution programs. To me, this vote of confidence in expenditures of this sort represents a big step in the right direction. However, as the expenses of combating pollution come closer to home, as in the case of bond issues or taxes to upgrade a city's waste treatment facility or business expenditures to install or renovate an industrial treatment facility, this positive attitude may diminish. But, even in this regard, a more enlightened attitude seems to prevail. All segments of our society - municipalities, industries and individuals - appear to be more willing to pay the price for clean air and water.

On the other side of the ledger, aroused public interest has created some minor problems. The notoriety given to industrial pollution far exceeds that which is given to the pollution which daily spews forth from our cities, towns and private residences. Industry, as a whole, bears much of the responsibility for the problem, but is the recipient of even greater amount of the furor. Cartoonists, wishing to stir our anti-pollution sentiments, invariably will depict a bleak industrial complex billowing with smoke and discharging pipes full of apparently lethal wastewaters.

I make this point, not to exculpate a wrongfully maligned industry nor to pass the buck from industry to cities, but to make these two points:

(1) First is this - No one can come to the environmental table with clean hands. We are all, in varying degrees, responsible for environmental degradation. Industries, small and large, urban or rural, cities of every size, and every inhabitant of this land contribute, in one way or another, to the problem.

(2) Secondly, disproportionate emphasis placed on one segment of the problem may result in other areas of concern going unnoticed and/or unremedied; or cause radical or unreasonable attitudes toward the highlighted segment of the problem.

On this last point, some elaboration may be helpful. Public involvement is undeniably a vital cog in the machinery of any pollution program. However, when over-aroused public sympathies produce "ultra-conservationists", undesirable pressure for hasty and ill-advised legislation and regulation often results. The "ultra-conservationist" would halt any use of our resources which conflict with the maintenance of a pristine and natural environment. They fail to recognize the practical necessity of a multiple-use of our resources. They would seek to rectify a century of environmental indifference in a day, a month, or at the outside a year. Those who use the resources to provide services and products for profit are labeled exploiters. As a result, there is movement afoot to enact legislation and administrative policies which would effectuate a "curing of the environment" on an emergency basis. I think we all can appreciate that certain extraordinary situations will warrant emergency action but, in the main, our overall programs and regulatory activities should not be geared to achieve instant environmental utopia. Such control measures would be both unrealistic and undesirable. But, make no mistake on this, we should make significant headway and be ready to bring the laggard to task.

Now, let us focus on the particular facet of the pollution problem which concerns us today - animal waste management.

The Feedlot Industry

Upon reviewing today's program, I was impressed with the broad list of topics and the many distinguished speakers who are scheduled to appear. Almost every aspect of animal waste management will be covered, a fact which unfortunately leaves me little to discuss. Consequently, I have decided to limit my remarks to a general commentary on the challenges which confront the feedlot industry and the preferred attitude or response to those challenges.

The fed cattle business is currently experiencing a rather rapid expansion. In terms of its growth, complexity and techniques, it is a newly-emerged modern industry which, not unlike any number of other industries, is beset with problems and growing pains. For example, other industries seek process refinements to meet modern demands and, in so doing, develop fantastic computers, transistors, rocketry skills, or what have you. In the cattle business, the demand is for higher quality and lower costing meat products. To keep pace with this demand, the industry must research and explore areas such as the genetics of breeding and the control of food intake and environment. There is also, as in all non-monopolistic industries, the element of competiton. The cattle business is no exception. In addition to domestic competitors, the individual operator must also contend with Argentinian, Mexican and other foreign imports. In some instances, the costs of waste

management, not present in foreign or some domestic operations, could work a competitive disadvantage on certain people; but, in more instances, the investment in proper waste facilities returns dividends of higher quality cattle and those seemingly intangible benefits of an improved environment.

To illustrate the growth of the industry, I will refer to the growth figures of the state with which I am most familiar. I trust that the seeming abundance of references to that state will not give the impression that I am suffering from that trait so often associated with the residents of that state.

Texas statistics bear out the rapid expansion of the industry. In the three year period from 1965 to 1968, cattle feedlot inventories reflected a 66% increase. In that same period, feedlot statistics for the 32 major cattle feeding states increased from 9,348,000 head to 11,297,000 head. This was a 12% gain and increases in Texas represented 17% of the 1,949,000 head increase. Most of this growth took place in a 33 county area known as the Texas High Plains which experienced an amazing 146% increase in cattle inventories over that three year period.

The future holds portents of even greater expansion. The Texas Cattle Feeders Association reports that in 1968, some 2,150,000 head of cattle were fed in Texas feedlots. By 1975, this figure should just about double.

The Environmental Challenges

As a vital link in the food supply chain, the industry's value and growth are well recognized; and, as our population continues to skyrocket, the demands for food supplies will increase correspondingly. Along with the industry's growth, there has been a fuller appreciation by the public and by the industry itself that serious environmental problems exist and must be overcome. Foremost of these has been the pollutional consequences resulting from the liquid and solid waste generated by feedlots. The problems is not new, but rather newly intensified and newly recognized. In the not too distant past, feedlots were, by design, situated in such a manner that wastes were allowed to run off into nearby draws or other natural drainage features. The only thought in mind was the ease in the removal and disposal of waste materials. Stream pollution was a secondary consideration; unless it directly affected ones usable water supplies. Furthermore, there existed a general degree of isolation which caused many of the environmental problems to go unnoticed. Stream degradation was intermittent and because of the fewer cattle involved, it did not cause major problems. The characteristic "healthy odor" was the sweet smell of success to the operator and did not disrupt too many neighbors.

Today, this is no longer the case. Increased urbanization and increased numbers of cattle have brought about a heightened degree of incompatibility between the industry and its environment. Add to this a new public awareness of pollution problems and the deeper development of the responsibilities of public agencies and the end result is a much changed socio-political climate. A climate in which operational laxities will no longer go unnoticed and uncorrected.

Animal waste in general and feedlot waste in particular, because of their tremendous concentrations, pose significant environmental problems in three major areas. These are:

(1) Fish and other aquatic life and recreational uses;
(2) Potable water supplies both surface and subsurface;
(3) Land usages and esthetics.

Fish kills provide a graphic and painfully visible picture of the consequences of pollution. Of the recorded fish kills which occurred in 1967, agricultural wastes were ranked as the number one killer. Feedlot wastes were a key causative factor in this regard. The literature in this field contains numerous instances of feedlot-caused pollution. Generally, they all point out how organically-ladened wastewater runoff had depleted the oxygen content of receiving streams and had raised ammonia levels above the point of endurance. One writer's experience was particularly tragic. He had observed a slug of animal wastes enter a stream and disperse for a considerable distance. Afterwards, fish were observed surfacing and attempting to obtain life-giving oxygen from the air. Crayfish were seen struggling out of one of the stream's banks and returning to the oxygen-less waters. Analysis of that stream showed that the dissolved oxygen content to be zero and the ammonia content was seven milligrams per liter. Both made aquatic life a virtual impossibility and sport fishing, or for that matter, any fishing were futile exercises.

In other recreational areas, water contact sports such as swimming, skiing, and scuba diving can all be adversely affected by the uncontrolled runoff of feedlot wastes. Over and above the simple undesirability of swimming in befouled waters, there exists the ominous spectre of disease bearing organisms being present in these waters. Over 50 known diseases can be transmitted aquatically from animals to man.

Potable water supplies will always head the list of resources to be preserved. Insofar as surface supplies are concerned, the threat of feedlot runoff is an intermittent one. This does not mean it can be ignored for recurrent contamination of this sort is not a risk we can afford to run. We have been fortunate that water treatment techniques, to date, have been able to supply us with safe drinking water and while slugs of organic contaminants are usually treatable, the costs of treatment are doubled and tripled.

In the groundwater department, we encounter similar problems. Common practices in feedlot waste management call for the impoundment of waste runoff in lagoons or pits for either evaporation or for disposal via irrigation. In the Texas High Plains, groundwater is a principal source of supply and the impoundment of this waste material can result in seepage contaminating this supply. Irrigation also poses problems; some known and others not yet fully understood.

Finally, there are the problems of land uses. The increasing number of complaints registered with public agencies and the rise in the number of lawsuits filed evidence the nuisance capabilities of feedlots. Odor problems, fly and insect breeding, and related problems are the most common causes. Generally, the presence of a feedlot places limitations upon the desirability and uses of adjacent land. Frequently, the friendly relationships between neighbors becomes strained.

Industry's Response

In the preceding section, I have touched upon the major environmental challenges confronting the industry. While my remarks have been something less than specific or detailed, I think we all are aware of the magnitude and complexity of these problems. I also hold the opinion that these challenges can best be overcome by means of an effective and active alliance between the industry and the responsible regulatory agencies.

In the Southwest, it has been my experience that the industry has accepted recent regulatory activities, not as a bitter pill, but rather as a necessary and worthwhile endeavor fully deserving of their best efforts. Rational state regulations have not been fought. In point of fact, the industry has taken initiative in sponsoring and cooperating in research for the development of sound waste treatment and/or disposal techniques. These and other reasreach efforts are essential, for there are many voids in our storehouse of knowledge. The feasibility of totally controlling the feedlot environment, the consequences of impounding and irrigating with feedlot runoff, and the most efficient and economic feeding process are all areas in which we lack full understanding.

Today's program will provide a

much more detailed examination of some of the problems which I have outlined. The point which I would like to leave with you is this —

There are almost as many theories on how to cope with the pollution problem as there are sources of pollution. If the fed cattle industry balks at the challenges confronting them, there will always be a theory of control available. It has been my legislative experience that the preferred regulatory situation is the one in which an effective harmony exists between the regulator and the regulated. The undesirable situation is the one in which a fruitless discord exists between the recalcitrant regulated parties and the concerned regulatory agency.

As I mentioned earlier, there has been to date, very little foot-dragging on the industry's part. There have been some conflicts but these have proven to be productive rather than destructive. The initiative, the cooperative spirit and the progress, which the industry has made, have been exceptional. But, in the same breath, we all know that much still remains to be done. I personally am confident that the cattle feeding industry will continue to meet its responsibilities to the public and to the environment.

ANIMAL WASTE POLLUTION - OVERVIEW OF THE PROBLEM

John M. Rademacher, Director
Missouri Basin Region
Federal Water Pollution Control Administration

Representative Clayton, you have not only set the stage with your excellent keynote address but also have made my job of overviewing the problem much simpler. In fact, I will only elaborate on certain of the technical points and with Mr. Jessee's help, illustrate some of the problems we all face in animal waste pollution control. In viewing this problem the vast and complex nature of animal waste pollution control dictates a cooperative program based on Education, Research and Regulation.

Representative Clayton cited some of the key figures on the production pattern of feedlot growth and it is always startling to compare the relative waste loads produced by animals with that produced by man.

Animal Production

The volume of animal waste produced in the United States is about ten times that produced by the human population. According to the U. S. Department of Agriculture, two billion tons of livestock wastes are produced annually in the U.S.A. The waste production by domestic animals in this country is equivalent to that of a human population of 1.9 billion. (1)

An estimated one-half of this waste comes from animals in confined feeding. The feeding of livestock in confinement is firmly established in the U.S. For example, the number of cattle on feed for slaughter was over ten million in 1966. This represents a 66 percent increase in the preceding eight years. During that eight year period the number of cattle on feed in the U.S. increased at the rate of one-half million head per year.

The magnitude of the problem caused by feedlot operations is reflected in the statistics for feeder cattle. Data compiled by Loehr show the waste population equivalent of feeder cattle is greater than the human population in each of the 10 Missouri River Basin States.(2) In only six other states is this the case.

The Missouri Basin States of Iowa, Nebraska, Colorado, Kansas, Missouri, North Dakota and South Dakota feed approximately 50 percent of all slaughter cattle. This activity will continue to increase. Iowa leads the nation in the number of cattle and calves on feed. In 1967, more than 4 million beef cattle were marketed from Iowa feedlots. These animals in Iowa will produce wastes, on a BOD basis, equivalent to approximately 40 million population. Many beef cattle feedlots have a 2,000 head capacity and 10,000 head lots are not uncommon. The trend is to larger and larger lots. For example, one lot in Greeley, Colorado, handles approximately 100,000 head of cattle.

Examples Of The Problem

There is evidence that animal wastes are a major source of water quality degradation. Feedlot runoff contaminates water supplies, destroys fish and aquatic life in streams, and generally degrades water quality. I do not want to take the time to cite all the examples of the problem as Mr. Jessee has some slides which graphically illustrate the problem.

FEEDLOT POLLUTION SLIDE SHOW

Randall S. Jessee, Public Information Officer
Missouri Basin Region, F.W.P.C.A.

Let's face it. A major source of pollution in the Missouri Basin is agricultural waste. One of the major sources if not THE major source is feedlot pollution. We each consume about 150 pounds of meat per year and with our population booming and incomes rising the demand for meat and other farm produce is bound to rise. Today feedlots are a big industry. Up to 100,000 in one lot with investments running into millions and millions of dollars. Today there are over 46,000 feedlots in Iowa and over 24,000 in Nebraska. I don't know how many there are in Kansas and Missouri, but I think it is a safe assumption that in varying degrees somewhere near the corresponding number exist in those two states. Last year Iowa led the nation in numbers of slaughter beef animals fed. Over 4 million cattle were on feed. The wastes generated by 100 cows are equivalent to 8 to 18 hundred people. That gives Iowa, with two and three quarter million people the equivalent of a waste population of over 60 million people. A city contributes its waste load daily at a fairly uniform rate. There is usually a treatment facility of some sort provided for a city and these are growing thanks to joint State and Federal efforts. Feedlot pollution is something else. Feedlot pollution too often occurs as a slug load washed into the stream after moderate or heavy rains. Here's what happened to one such slug load in Kansas in April, 1967.

SLIDE ONE

This is the entrance to John Redmond Reservoir. Burlington used to be called the catfish capitol of the world, but they are thinking of chopping this

sign down..maybe they already have.

SLIDE TWO

Scum from feedlot runoff and the mucus stripped from the fish.

SLIDE THREE

This is cattle runoff from near the feedlot with an extremely high nitrate content and zero oxygen.

SLIDE FOUR

These fish are three days old, the sun is hot...they smell. They are just a few of the over half a million fish counted.

SLIDE FIVE

More of the same.

SLIDE SIX

Scum due to the feedlots runoff which stripped the mucus from the fish causing internal hemorrhaging.

SLIDE SEVEN

Other fish besides catfish were killed.

SLIDE EIGHT

Many of them were pretty big fellows.

SLIDE NINE

The sun was shining here too, and these rested..permanently..in the hot sun next to a dam.

SLIDE TEN

Here's an example of the type of feedlot which can cause such pollution. Thousands of cattle high on a hill with tons of manure ready to cascade directly into the gully below and then to the river..all it needs is a good rain.

SLIDE ELEVEN

A smaller lot, but conditions are the same. Directly into the river.

SLIDE TWELVE

This is man and animal made mud. The negligence of man and the waste from the cattle and a little rain. Excellent conditions for hoof rot and flies in addition to the pollution of air and water.

SLIDE THIRTEEN

Here's the type of mass that can move down a river after a good rain. More waste than water.

SLIDE FOURTEEN

Then the sun comes out and it begins to dry and the gas begins to bubble.

SLIDE FIFTEEN

Here conditions are even worse. The grade is so slight that the waste moves with all the speed of a turtle.

SLIDE SIXTEEN

This waste from a feedlot runs directly into a roadside ditch and continues down the road quite a ways before it pollutes the main stream. REMEMBER, THIS IS A ROADSIDE DITCH.

SLIDE SEVENTEEN

A combination of erosion and waste from a feedlot, compounding the felony.

SLIDE EIGHTEEN

This is four long and stink filled days after the big rain. The rotting vegetation combines with the waste to generate even more gas and pollution. Only the flies are happy.

SLIDE NINETEEN

How would you like to live in a town just three miles downstream from this feedlot. This is the water supply for that town only three miles away. Maybe the cattle get cleaner water to drink than the human beings downstream.

SLIDE TWENTY

This is a different feedlot. Scraped dry and clean. Ready to have the cattle brought in again.

SLIDE TWENTY-ONE

The cattle are not overcrowded and are protected from drinking polluted water.

SLIDE TWENTY-TWO

In case that gully washer does come, this diversion terrace will take care of a lot of the runoff.

SLIDE TWENTY-THREE

But the cattle runoff is not through an open ditch or into a stream or river it goes into a covered drain....

SLIDE TWENTY-FOUR

Drains are of several types as conditions warrant and there is no open ditch to be stinking in the sun four days later.

SLIDE TWENTY-FIVE

This runoff from the lot goes into a large lagoon which is a primary treatment facility. There is enough water here so that there is little if any odor and the sun is able to get in its work in nullifying the pollutant effect of animal waste.

SLIDE TWENTY-SIX

Then into the secondary lagoon where air, sun and water combine to use nature's facilities in cleaning up the waste which is no longer harmful as it leaves the second lagoon and goes into the fields nearby.

SLIDE TWENTY-SEVEN

Grass and crops grow from the nutrients left in the once harmful polluted waste. Nature's cycle has been completed and everyone has benefited. Is this more sensible ... or is this ...

SLIDE TWENTY-EIGHT

Those same cattle ..feeding, drinking, polluting only three miles from the water intake to supply a rural municipality just three miles downstream from this lot. What are we going to do about it? That's what this conference is all about. Thank you.

John M. Rademacher (continued)

Effect Of Animal Wastes On Ground Water

One area of concern which has not been mentioned is the effect these wastes have on ground water.

In a statewide survey the University of Missouri analyzed more than 6,000 water samples in Missouri. Forty-two percent of the water samples contained more than 5 parts per million nitrate as nitrogen.(3) In some counties in Northwest Missouri, over 50 percent of the wells sampled contained sufficient nitrogen to be of concern in livestock production. Data obtained indicated animal manure to be one of the major sources of nitrate in water supplies. There was a definite statistical relationship between livestock numbers and shallow wells containing nitrate.

Agriculture's effect on nitrate pollution of ground water was also investigated in the South Platte River Valley of Colorado. Most of the 621,000 cattle in Colorado feedlots (February 1, 1967) were located in this Valley. Data obtained showed that nitrate under feedlots is moving through the soil and into the ground water supply. Since the feedlots are usually located near the homestead, they may have a pronounced effect on the water quality from domestic wells. The findings that water under feedlots frequently contained ammonium and organic carbon cause further concern about the effect of feedlots on underground water supplies.(4)

The official State Enforcement Agencies are assuming their responsibility in animal waste control. Seven of the 10 Missouri River Basin States have enacted or are now in the process of enacting, feedlot regulations. However, leadership in animal waste control is not limited to the official agencies. Research has been underway in the State Agricultural Experiment Stations regarding the characterization, handling, and utilization of animal manures since the turn of the century. As far back as 1891 the Cornell (New York) Station reported on such research.

The U. S. Department of Agriculture and many other Federal and State Agencies are conducting studies related to agricultural pollution. For example, eight of the 16 water resource research projects now being conducted at the University of Kansas deal with water quality management and protection. Abstracts of 4,193 projects are contained in an inventory of water resources research compiled by the Science Information Exchange of the Smithsonian Institute published in December, 1967. It is encouraging to note that several hundred of these projects deal with pollution from agricultural activities. The U.S.D.A., State Agricultural Experiment Stations, Universities, Colleges and others are

to be commended for their excellent work.

Let us now examine where we are and where we want to go in the animal waste management field. Several of the speakers, I am sure, will elaborate on the mentioned research projects. However, if research is to be beneficial the findings must be put into practice. This means a free interchange of data among all agencies, groups and individuals.

The acquiring of the technical information is the first needed step — the full development of the technical base. This does not mean that control actions should or will wait for the full development of the technical base. Rather, it means that control efforts must be intensified now utilizing the known information. Concurrently, the technical base will be strengthened.

The technical base incorporates, among other items, a thorough knowledge of the waste sources, the water uses and the water quality and quantity. Responsibility for use of these items of information rests with the Federal and State Water Pollution Control Agencies although the resources of other Federal and State Agencies and the industry normally provide significant inputs to this data bank system — and this goes beyond the normal meaning of cooperation — it means *participation* on the part of all parties.

An adequate public base must be developed to support the technical base. The public base is a function of education and in matters of water pollution the reaction has been for the most part *very, very* positive. However, in the case of animal waste pollution control a new dimension has been added. For the most part the public has believed that this was "natural" or background pollution.

The fish kills, the NO SWIMMING signs, the destroyed esthetic values will be the biggest demonstratives for a call to action, *if* we do not face this problem squarely. Many values are involved in building a national or local policy for any important issue or problem. Multiple disciplines are necessary instruments in translating established policies into an operating program. There will be decisions, many of them difficult, regarding the degree of control. And the public base will play a role in this decision making. Given the complete story, the public will support a program that will mutually benefit all segments of society.

The development of an adequate political base is one of finding and knowing the proper keys to turn to implement a pollution control program. For example, in a city or town the key man to secure good operation of a waste treatment plant is not the operator, but is the mayor, the utility superintendent or the board president. Education and motivation of these people are essential to good plant operation. We must secure the cooperation of legislators. Our keynoter, Representative Bill Clayton, and former Senator Joseph, are excellent examples of the type of support needed to develop sound programs. Both of these gentlemen have assumed leadership in the animal waste management programs in their respective States of Texas and Kansas. The success of any major national or local program depends, to a large degree, upon the support received from the executive, judicial and legislative branches of all levels of government.

Public recognition and open discussions constitute a major step toward the solution to this major problem. We believe this Conference will provide a much needed model for action.

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INDUSTRY'S ROLE IN FEEDLOT POLLUTION CONTROL

Charles B. Joseph, Liaison for Governor of Kansas
Feedlot Operator, Potwin, Kansas

In attempting to establish the position to be occupied by the livestock industry relating to the problem of the control and management of feedlot waste, it seems pertinent that we briefly review the historical development of the cattle feeding industry.

In Kansas, surrounding states, and throughout our nation, we have witnessed a revolution in the cattle feeding industry during the past fifteen years. Formerly, the bulk of cattle feeding was done on our farms and by the farmer-stockman who owned and operated his own feedlot. The livestock farmer has previously been our principal beef producer.

In Kansas today, cattle in feedlots with over 1,000-head capacity have increased in excess of 700%, and are producing over half of our total beef production. To illustrate this spectacular growth, we note that in 1956 our state had 182,000 head of cattle in feedlots with only 30,000 of this number being fed in commercial feedlots with a capacity in excess of 1,000 head. However, in 1969, we have 766,000 head of cattle on feed in which 486,000 are being fed in commercial feedlots with over 1,000-head capacity. During this period of rapid development in the feeding industry, the consumption of beef in the United States has increased from approximately 60 pounds per capita to 170 pounds per capita. We are hoping it will continue to increase.

Motivated by economic necessities arising out of a highly competitive industry, accelerated expansion of the large feedlot will no doubt continue. New packing plants are following feedlot expansion locating close to the source of beef supply. This is a significant industrial expansion that is directly related to our natural resources. The feedlot and packing plant development is making a constructive impact upon our economy. It is important that this growth be encouraged and that we act prudently to prevent the development of any hindering influences. To do this, it is imperative that we establish a proper role to be played by the livestock feeding industry in coping with problems created by it which directly affect the public interest. One of those is feedlot pollution control.

I would propose that our industry develop specially-formed groups or committees to act as spokesmen for and represent the cattle feeding industry in all problems relating to the management of waste and pollution

control. Many qualified and informed persons are available within the ranks of the industry. Let us utilize their talents. Such groups could serve in any number of capacities, developing improved public relations, and more particularly acting as liaison between the industry and the various federal and state agencies charged with the responsibility of representing the public interest in pollution problems.

It would be futile to deny that the development of our modern and efficient feed yards has created difficult problems - especially in the area of organic runoff and water pollution. The concentration of waste matter resulting from the placement of enormous numbers of cattle in relatively small areas cannot be "swept under the rug." Sampling of our streams following runoff further confirms the problem, and the resulting fish kills dramatically illustrate it. There are other less spectacular but equally serious aspects. A gradual increase in the nitrate content of underground water supplies is a potential danger we must avoid.

The development of large-scale feeding operations first occurred in the irrigated areas of the Southwest and in California. Because of the lack of rainfall and the virtual non-existence of runoff water, water pollution was of little significance in these areas. They were concerned with problems of dust, manure removal, and odor. With the growth of feed yards in Kansas and other areas of considerable rainfall and runoff, the industry began to experience the new and complex problem of organic runoff and resulting water pollution. In fairness to a number of the earlier constructed feed yards in our state, the problem developed too rapidly for the operators to anticipate and plan for its solution. Some of these installations grew and developed on sites incapable of coping with organic runoff problems. They were developed in good faith and without awareness of the problems which subsequently developed. They continue to be situations difficult to solve.

Water pollution is not a new problem. Historically it has been associated with all kinds of industrial development. In the Southwest one of the water polluters has been the oil industry. Here many formidable problems have been solved. This is the basis of our confidence that feedlot pollution control will be accomplished in a manner which protects both the public interest in clean water and the feedlot industry. It is the public agent who must encourage and coordinate the efforts of all to find solutions. We must maintain an "open door policy" between the feeder and the public via the concerned public agencies.

New construction must be properly screened to avoid repetition of past errors. New sites should be chosen based on the ability to control organic runoff as well as meeting conventional standards of good feeding terrain. Registrations, pollution permits, retention ponds and lagoons are realities we must learn to live with.

Our industry should further encourage research into new uses for animal waste. Tax write-off incentives need to be extended to feedlot owners to cover the cost of adequate control and disposal facilities, the benefit of which inures solely to the public interest and adds little or nothing to the productive efficiency of the owner. We should stress that the feeding industry cannot absorb the cost of sophisticated disposal installations as presently used by our cities. However, we can and should develop ability to control and regulate organic runoff, and in cases where necessary, properly dispose of the same. We will continue cooperative efforts with our colleges, universities, and all other groups engaged in research efforts. We must maintain good housekeeping within our yards.

The small feedlot is passing from the scene, yielding to economic pressures. The large commercial feedlot continues to expand; the number of cattle in these lots have increased 44% in the last year. Modern packing plants are developing in adjacent areas. In Kansas, we have a meat slaughtering industry with a wholesale value of $600 million. New construction will increase this kill capacity by more than 50%. We cannot afford to jeopardize these developments. It is imperative that our industry continues to exert all feasible efforts in solving the problem of feedlot pollution control.

Let us reaffirm our collective industry efforts to propose and present pollution control devices that are economically feasible and socially acceptable to a nation which is constantly demanding increased amounts of useable water.

HOW TO CONDUCT A STATE INVENTORY

John P. Badalich Director
Minnesota Pollution Control Agency

The most important aspect of any feedlot inventory is the financing necessary to undertake such a project. Every government agency and private association is under limited budget and the object of any study must be justified.

We, in Minnesota, had to do no mental gymnastics to realize something may have to be done. Minnesota is a state with many farms and agriculture enterprises. This is the magnitude of the problem, in summary, according to information from the Department of Agriculture, University of Minnesota. In the state, there are fourteen million chickens and turkeys, four million cattle, one and one half million dairy cows, two and one half million hogs and three-fourths million sheep. Wastes from these animals represents a population equivalent of sixty-six million people. The state only has a population of about 3,413,864 (1960 census). This survey gives starch to a suspicion that we might have a problem. However, in Minnesota, there has been no case of serious water pollution from feedlots or manure piles as measured by a fish kill. Our files do show complaints because of odors or nuisance conditions.

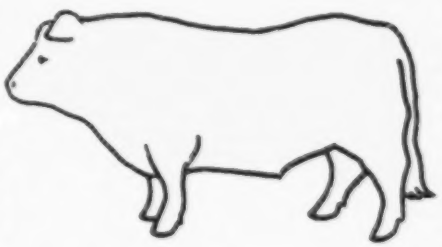
Not long ago, cattle were raised on pasture land and range land and there was not much confined feeding. Now cattle are confined for a portion of their lives.

Manure is usually stored because it can only be spread during the spring and fall, however, there is no requirement yet to abstain from spreading manure in the winter. This requires the storage of animal wastes until the appropriate time for disposal.

In 1967, an investigation of livestock feeding operations was made to estimate the magnitude of these sources as contributors to the pollution of Big Stone Lake, a long shallow lake bordering Minnesota and South Dakota. The area watershed, consisting of approximately 626 square miles in Minnesota, was used mainly for farming.

This particular investigation consisted of actual field observations at 17 of the 40 livestock feeding operations in the watershed along with interviews with the operators, taking of photographs and collection of water samples from nearby streams for laboratory analysis. The field observations recorded consisted of the general characteristics of the livestock feeding area, such as topography, ground cover, general drainage, estimated flow of tributory stream, and in addition, livestock census data and information on manure disposal. The laboratory analysis checked such parameters as coliform organisms (total anu fecal) suspended solids, BOD, phosphorous, nitrogen and total solids.

It was concluded by our technical staff that area drainage and solid



Locate, Enumerate and Evaluate

wastes from some of the livestock feeding sites in Big Stone Lake watershed, at times, contributed significant amounts of pollutional materials to the lake.

The limited survey of livestock feedlots conducted in the Big Stone Lake watershed, represented sixteen manhours of actual field surveys indicating that some other practical method of survey should be developed.

Based on this limited study and the great probability of the runoff of animal wastes to our rivers, lakes and streams, a preliminary draft of a regulation for feedlot control was drafted for discussion. The response of agriculture interests was vigorous, determined and with resolution. However, in most cases, after questions were answered, most people pretty well realized something must be done. We feel more questions must be answered to assure the critics of the regulation. If the Agency, which is the Water Pollution Control authority in Minnesota, approves the regulation as finally prepared, we will be ready to canvas the state to identify these sources.

The U. S. Department of Agriculture tells us that Minnesota has 19,900 feedlots, that is a lot of lots. It is clear that a canvas must be made by mail. The agency just doesn't have the personnel for a personal investigation and even a mail survey would require many manhours and considerable expense.

This is clearly indicated by the limited experience we had in the Big Stone Lake area. Based on the time spent in field surveys on this project it would require approximately 2,340 mandays to survey the feedlots in Minnesota.

Some preliminary screening can be done by questionaires, which could be sent to households in rural areas. A similar survey was solicited by mail by the U. S. Department of Agriculture during the 1959 United States census. However, Federal regulations do not permit the release of such information. We believe that local farm agents would cooperate in this work and could identify some feedlot operations.

This cooperation was brought forth just this past summer by Minnesota's Soil and Conservation Districts after release of the preliminary draft of our feedlot regulation, WPC-22. Of the eighty-nine Soil and Conservation Districts in Minnesota, sixty or sixty-eight percent responded or commented on these regulations. It may be interesting to note that thirty-seven of these districts indicated a need for control where animal wastes could discharge directly to a stream or lake. Therefore, again based on a limited survey, it is shown that the livestock feedlot industry is concerned with the pollution of our waters and are willing to cooperate in this matter.

The mailed questionaries, as received, would have to be processed in the office for completness. Incomplete information could be obtained by follow-ups. We would expect that some farmers would not return the questionaires. These would require further contacts by mail and even personal visits.

An aeroplane reconnaissance of certain highly suspected feedlot pollution areas could be made. This would afford a quick and sure evaluation of the drainage of the feedlot to the river.

Ideally, the form could also obtain information on commercial fertilizers used on croplands, land uses and pesticides. The runoff of nutrients from fertilized croplands into surface waters is a problem which will have to be faced in the future. Some people believe that in order to cut down the pollutional load on our waters, crop fertilization should be done in the Spring.

The questionaire should not be an application for a permit. To require

very detailed information from a farmer whose operation causes no pollution may place an unnecessary burden on the farmer. Then, the additional staff needed to prepare permits, if permits would be issued for all applications, would be great.

An administrative judgment can eliminate farm operations for which no permit would be needed because of lack of actual water pollution. There is no need to concern a farmer with a permit unless the issuance of the permit seems reasonably necessary.

The inventory should show:

(1) Is there any surface water diversion around the feedlot? Exact location of feedlot or manure pile in relation to a stream or lake and water wells. The distance of the feedlot to a surface water course.
(2) Size of the area.
(3) The type of animals, poultry, sheep, dairy cows, beef cattle, etc. There are different physical and chemical properties of animal wastes for different animals. The live weight of a particular species affects the amount of wastes produced.
(4) Nearness of dwellings to the feedlot is necessary to pinpoint possible nuisances which may arise.
(5) The number of animals.
(6) The type of confinement, such as concrete slabs, etc. Some feedlots have a slated pit into which manure is flushed or deposited by farm animals. Some animals are under semi-confinement. Under this arrangement, a place for feeding is provided where much of the manure would be deposited and adjacent open area for grazing.
(7) The surface water drainage in the area.
(8) Any water pollution control devices? If manure is handled as a liquid, treatment of these wastes is very difficult for meeting the standards of water quality and purity for the state. The only practical method of treatment seems land disposal such as ridge and furrow and spray irrigation. Detailed description of structures, or devices utilized primarily for water pollution control, and method of operation.
(9) The type of soil topography and vegetative cover.
(10) Is the manure handled as a solid or a liquid? Bedding or litter may be used to absorb the liquid in manure. However, there is a trend to not use bedding and the manure is flushed out with water.
(11) A review of climatological data may be helpful to identify the seriousness of the problem. Rainfall data is necessary for an appreciation of the pollutional load from feedlots.
(12) The feedlots should be grouped according to basin. Information received should be tabulated so some decisions can be made as to the water pollution potential. An estimate of runoff can be made using the information recorded and empirical formulas developed in the literature. There are mathematical expressions from which estimates of BOD can be computed.
(13) Detailed description of the operation - (operating season, date purchased, date marketed, weights, etc.).
(14) Nature and type of feed, and method of feeding.
(15) Location of fences in relation to streams and lakes (pastures and/or lots or enclosures).
(16) Final disposal of solid and liquid wastes, raw or treated.
(17) Name of the operator.
(18) Location - (legal description if possible).

If everyone who operates a feedlot in Minnesota were to reply, we would have 19,900 questionaires that would have to be reviewed, tabulated and evaluated. Clerical employees should be able to eliminate many of the questionaires based on smallness of operation and remote locations from surface waters. In Minnesota some topographical maps are available in a scale of one inch to about 20,000 feet. Some of the feedlots could be located on these maps to determine the probable seriousness of animal waste pollution to a watershed. We believe that the best approach to control water pollution, in this case, is by the basin method.

The feedlot operators who need water pollution control devices for their operations would be notified to submit plans and specifications for waste disposal facilities. Plans would be reviewed by the technical staff for conformity to regulations and permits issued. We would expect to have investigators review in the field, the waste disposal operational practices of the larger lots.

This is a plan on paper and many problems which can't be anticipated are sure to arise. However, our purpose is clean waters for all the people of Minnesota and in this framework the solution will be found. We, of course, are mindful also of our obligations to the Federal Government and to our Brother States to protect and maintain the quality and purity of the interstate waters leaving Minnesota for the benefit of the rest of the nation.

HOW TO CONDUCT A STATE INVENTORY

Frank J. Rozich, Director,
Water Pollution Control Division
Colorado Department of Health

To begin with, I might state that I am at a loss as to why I was the particular one selected to expound on this subject since I am sure any one of you here has had as much experience in conducting feedlot inventories. The reason I say this is that prior to March of 1966, no Colorado State Agency had control over wastes discharged by feedlots. Our old water pollution control law restricted our activities to only those wastes that contained human wastes. So you can see that our jurisdiction in this field was obtained approximately three years ago with the enactment of the Colorado Water Quality Act of 1966.

During 1966 and most of 1967, we, like all of the other States, were busy preparing our water quality standards and plan of implementation. In preparing our plan of implementation, we learned from our Department of Agriculture that there are approximately 1,127 feedlots in Colorado. Of this number, as of January 1, 1967 - I don't have later figures - 1,027 are operated by members of the Colorado Cattle Feeders Association and approximately 100 feedlots are operated by members of the Colorado Cattleman's Association. Approximate sizes for the 1,027 feedlots included in the Cattle Feeders Association are as follows:

0 - 500 beef	850 feedlots
500 - 1,000 beef	90 feedlots
1,000 - 5,000 beef	59 feedlots
5,000 -80,000 beef	28 feedlots

One feedlot accommodating 80,000 beef is reportedly the largest in the United States. Two-thirds of all cattle on feed in Colorado are accommodated in the 28 larger feedlots. About 232 of the 1,027 feedlots are full time operations and the remainder, part time. Feedlots operated by the Colorado Cattlemen's Association are generally smaller part time operations.

Although some few fish kills in Colorado have been traced to other industries, none have been traceable to pollution by the feedlot industry.

It wasn't until the latter part of 1967 and the early part of 1968 that we began to give serious consideration to the matter of pollution emanating from

feedlots in Colorado. We felt that our first task was to get more specific information, such as ownership, acreage involved in the various feedlots, the number of animals fed, and the location of the facility. Consequently, we again approached our Department of Agriculture for this information and were informed that recent information of this type was not available. They did, however, provide us with an old list of the various owners of such facilities and the location of such facilities. This list contained nothing on the size of the operation or the type of animals being fed. We then approached the Colorado Cattlemen's Association and the Cattle Feeders Association for this same information and were politely told that since they were private organizations, they felt that they could not release this type of information to a State agency.

We next contacted the Agricultural Extension Service of Colorado State University to inquire as to whether or not we might contract with them to conduct a survey of the feedlots in Colorado. They also informed us that since they are a service agency to the farmers in Colorado, they did not feel that they could conduct such a survey without standing a chance of jeopardizing their good relations with the farmers of the State. Consequently, it became quite apparent that if we were to obtain this information, we would have to do it ourselves.

In Colorado, State funds are budgeted to the various State agencies for specific purposes and cannot be devoted for any other purpose. For instance, if a certain sum of money were appropriated for personnel and we found that we could not recruit a full complement of personnel, the monies so saved could not be utilized for any other purpose. It must be returned to the State treasury. This is not true of Federal funds that we get. By making certain that the unfilled positions in our division were carried on Federal funds, we, at the end of the fiscal year or near the end of the fiscal year, were able to accumulate some funds so that we might consider the hiring of an engineering technician to begin a survey of the feedlots in Colorado.

Prior to recruiting a person to this position, we learned from a number of sources that there were certain factors that we had to consider.

We found that farmers and feeders maintain that there is no pollution problem from agriculture. They feel that this is a diversionary move to take the heat away from municipalities and industries. Some farmers will agree that studies indicate that agricultural pollution is a problem but they also maintain that there is need for more research into the problem.

As is true with any group, be he farmer, cattle feeder, miner, or steel worker, they all have the same reluctance to talk freely to someone unless he can talk their language and is, essentially, one of them. He should not only be able to converse freely with them on their level, but he should also dress and act the part.

I could say that these were all the factors that we looked into before we hired our technician, but this would be an untruth. Actually, we had placed an ad for an engineering technician. A person applied who, among his references, listed having worked in the laboratory at Colorado State University. Upon checking his references, we found that the professors at Colorado State University did not speak too highly of this individual. Although they could not recommend the individual in question, they pointed out that they had a man at the school who had completed two years of college and was in need of financial assistance in order to continue his college training. This individual turned out to be a farm boy who not only spoke the farmers' language, but also dressed and acted the part down to the cowboy boots, blue jeans, cowboy hat, and pickup truck.

This technician began work for us September 1, 1968. His first assignment was to inventory the feedlot facilities in the South Platte River Basin. However, before sending the individual into the field, we prepared a news release which included a short bibliography plus an explanation of why, how and where the survey was to be conducted. This was not only released to the papers around the state but also to publications of the Cattle Feeders Association and various farm journals. As a result, our man was well received when the field study got under way. During the first three months of the study, he was refused information by only three individuals. These were revisited two weeks later (after they had a chance to talk to their neighbors) and the information desired was obtained.

In addition to utilizing the services of an engineering technician, we also contacted our Milk, Food, and Drug Section and the local health units in the State and asked them to complete a similar inventory form as part of their routine inspection of dairy cattle facilities.

As of the end of January, 1969, the technician and local health units had visited 570 feedlots and in his estimation, approximately 20 percent of those inventoried could be contributing to the pollution of the waters of the State.

Where the inspection official has indicated a possibility of water pollution occurring, we are asking our district engineers to follow up and discuss this matter with the owner of the facility. If the district engineer concurs with the inspecting official's report, then the particular feedlot will be placed on our abatement schedule.

To date we feel that our feedlot study is progressing satisfactorily. Some problems may develop when we get into the enforcement stage of our program. We plan to keep a close watch on how effective this method of operation is in eliminating the pollution problem from this source. If we find that there is need for more forceful legislation, we may consider a registration act similar to the one presently in effect in Kansas. However, I don't feel that such legislation would stand much of a chance of enactment at present. Two years ago the Cattle Feeders Association sponsored a self-policing type of registration act. It was defeated by the farm lobby. Consequently it is my belief that much educational work is still needed before we can get through any bill calling for mandatory registration of feedlots.

Rules For The Control Of
Water Pollution
From Livestock
Confinement Facilities

I. Authority:
Chapter 44, Session Laws 1966, as amended by Chapter 217, Session Laws 1967, Sections 5(e), and 8.

II. Definitions:
- A. "Commission" means the Colorado Water Pollution Control Commission.
- B. "Person" means any individual, partnership, corporation or association doing business in this state, in whole or in part.
- C. "Livestock Confinement" means cattle, calves, sheep, swine, horses, mules, goats and fowl corralled, penned, tethered, or otherwise caused to remain in pens or corrals where feeding is other than grazing.
- D. "Feedlot Operator" means any person engaged in the business, as owner, operator or manager of a place, establishment or facility commonly known as a feedlot, and including any facility commonly known as a stockyard, veterinary clinic or other livestock confinement facility, consisting of pens or corrals used for the purpose of holding livestock for feeding and for holding such livestock for sale, shipment or slaughter or treatment.
- E. "Abatement Schedule" means

the prescribed time schedule for investigation, completion of plans, the construction of facilities and final date of abatement of pollution.

III. Prevention Of Water Pollution:

A. Every Feedlot Operator shall take all reasonable preventative measures to avoid the pollution of the waters of this state due to surface runoff waters or discharges from within feedlots or stockyard enclosure, or from manure or sludge storage areas appurtenant thereto.

B. To the extent necessary, minimum preventative measures shall include the construction of sealed collection and retention ponds; provision for adequate drainage to prevent the collection of surface waters within such enclosures or upon appurtenant areas; the use of mechanical means for scraping, cleaning and grading all areas which could contribute to water pollution; the disposal of animal excrements and other wastes, and the diversion of surface runoff or drainage waters prior to contact with contaminating areas or substances.

IV. Commission Requirements:

A. The Commission, upon finding the preventative measures utilized by a Feedlot Operator to be either inadequate to prevent water pollution or non-existent, may require a Feedlot Operator to adopt one or more of the foregoing stated preventative measures, and such other measures as the Commission may deem reasonably necessary to prevent water pollution, including the installation of a waste treatment facility for surface runoff waters or discharge water from within feedlot and stockyard enclosures and manure and sludge storage areas appurtenant thereto.

B. The Commission will establish a water pollution abatement schedule for each feedlot found to have inadequate preventative measures.

Wastes Inventory
Livestock Feeding Operations

DATE: _____

COUNTY: _____

Company Name & Address _____

Type of Operation: ☐ Feedlot ☐ Dairy Farm ☐ Other

☐ Stockyard ☐ Hog Farm _____

Average Stock Population (Give daily and monthly changes if any) _____

Total Stock Pen Area and Capacity _____

Are Stock Pens Paved? _____

Method and Frequency of Disposal of Manure _____

Does Method Control Fly Breeding? _____

Is Rodent Control Practiced? _____

Treatment and Disposal of Stock Pen Drainage _____

Stream or Water Body Receiving Drainage (Name, Distance, and Direction) _____

How is Area Zoned? _____

Distance & Direction from Nearest Community _____

Method of Dead Animal Disposal _____

Prepared by: _____

THE KANSAS ANIMAL WASTE CONTROL PROGRAM

J. Lee Mayes, Director,
Enviromental Health Services
Kansas State Department of Health

The Kansas program embraces wastes with water pollution potential from all types of confined feeding of animals. Because cattle feeding is the most important from the standpoint of both economic significance and water quality control, our discussion will center around the control of water pollution from cattle feeding operations.

The Department of Health first became concerned with cattle feedlot operations in about 1956. The concern was brought about by people living in the immediate area of feedlots who complained of nuisances due to odor and fly production. Odors and fly production are still a problem even though emphasis has been placed on drainage, clean-up, and pesticide spraying within the feedlots. The remaining problem is partly due to increased numbers of feedlots and increased size of individual lots.

Departmental concern was shifted to water quality control in 1959 when fish kills began occurring downstream from the very few feedlots existing in the state. It became apparent that the feedlot industry could become a significant water pollution problem with continued growth so that detailed investigations of pollution characteristics and growth patterns were undertaken in conjunction with research investigations at Kansas State University and the University of Kansas.

In the meanwhile, field investigation of water pollution episodes and fish kills continued. It was found that the degradation of water quality due to animal wastes is indeed a serious matter. The release or runoff of these wastes to our streams during periods of rainfall runoff produces "slug" flow of the polluting material which can traverse the receiving stream for many miles, kill all desirable aquatic life in its path, disrupt or prohibit the use of the affected stream for water supply purposes, and generally alarm the public.

By 1967, investigations at the two Kansas Universities and our own studies and investigations had developed sufficient information to allow the design of a control program which would yield significant results. Accordingly, in 1967 the Kansas State Board of Health adopted specific regulations for control of agricultural and related wastes. These regulations became effective on 1 April 1968. The regulations require containment and control by irrigation practices of all runoff from animal feedlot installations, with the minimum retention of three inches of surface runoff. The regulations and state law provide for considerable flexibility for department engineers, in that greater or lesser requirements may be imposed, based on engineering judgment and the specifics of each individual case. This regulatory approach has been based on hydrologic conditions, research factors, and common sense.

Average rainfall in Kansas varies

from 16 inches per year in the far west to 40 inches per year in the east. With these highly varying conditions it becomes apparent that each individual installation must be evaluated on its own merit if we are to realize satisfactory water quality control at reasonable cost. We do have extensive rainfall records at numerous locations throughout the state, and by means of statistical probability have developed factors for design of water pollution control facilities which we feel will be adequate.

For example, within the central portion of the state, two-day rainfall probabilities are five inches and eight inches for 10-year and 100-year probabilities respectively, while a 10-day rainfall of seven inches and 11 inches can be anticipated for a 10-year and 100-year probability of occurrence respectively. The probable maximum six-hour rainfall for 10 square miles is 26 inches. It is obvious that it is not practical to provide water quality control retention structures for the maximum probable rainfall occurrence, nor is it needed. During periods of widespread heavy rainfall, the water pollution aspects are considerably decreased due to the large dilution factor.

The basic requirements for water pollution control facilities with respect to feedlots have been based on the following factors:

1. The characteristics of wastes associated with runoff from feedlot areas are independent of the population equivalent of the feedlot.
2. Dry cleaning, that is mechanical removal of deposited wastes within feedlots, is impracticable in that it is not feasible to dry-clean a lot except during periods of feedlot pen turnover, which normally occurs between 90 and 120 days. Research has further shown that unless dry cleaning of the lot surface can be provided at intervals more frequent than two weeks, the pollution characteristics of surface runoff remain unchanged.
3. Because of the extremely high organic content of the wastes, both on a total basis and as surface runoff, it is technically impracticable and economically impossible to treat the wastes so that they can be discharged to the environment with immunity.
4. Waste water evaporation ponds are infeasible because of the large areas required in all except the western portion of the state, where rainfall is minimal and evaporation may exceed 80 inches per year. Even so, the area required for evaporation approaches the area of the feedlot if there is to be no overflow at any time.

Waste retention facilities are designed on the basis of the desirability of not having damaging overflow from these retention facilities more frequently than once in eight to ten years from the standpoint of statistical probability. This is accomplished by utilizing the retained liquid wastes for surface irrigation of crop land. Irrigation facilities are designed on the basis of completely dewatering the pond within a 10-day period after entrapment of rainfall runnoff. This will allow for partial drying of nearby fields over a period of several days prior to application of the liquid wastes.

Under the Kansas regulations, entitled "Agricultural and Related Wastes Control" (a copy of which is appended), the operator of any existing or

proposed confined feeding operation is required to register with the State Department of Health on a form provided by the department. The completed form, together with supplemental information regarding general features of topography, drainage course, and identification of ultimate primary receiving streams. The department may also require submission of additional information if deemed necessary for satisfactory evaluation of the application.

The regulations define confined feeding as follows: "The words 'confined feeding' shall mean the confined feeding of animals for food, fur, or pleasure purposes in lots, pens, pools or ponds which are not normally used for raising crops and in which no vegetation, intended for animal food, is growing. This will not include a wintering operation for cows in lots or on farming ground unless the operation causes a pollution problem."

The regulations also define confined feeding operation, as follows: "The words 'confined feeding operation' shall mean (1) any confined feeding of 300 or more cattle, swine, sheep, or horses at any one time, or (2) any animal feeding operation of less than 300 head using a lagoon, or (3) any other animal feeding operation having a water pollution potential, or (4) any other animal feeding operation whose operator elects to come under these regulations."

Other definitions needed to clarify those just presented are as follows: " 'Food animals' shall mean fish, fowl, cattle, swine, and sheep. 'Fur animals' shall mean any animal raised for its pelt. 'Pleasure animals' shall mean dogs and horses."

All registration applications are reviewed by the water pollution control staff, and unless the material submitted with the application makes it obviously unnecessary, a field inspection and evaluation of the site is made. Determination is then made as to whether or not water pollution control facilities will be required. If facilities for pollution are not required, a letter notifying the applicant of this fact is sent. This letter makes clear, however, that any proposed increase in the size of the operation or change in the physical layout of the operation shall be reported to the department, since such changes may result in a potential water pollution problem.

If control facilities are required, the operator is placed on a schedule for the development and completion of control facilities. Our staff engineers provide advisory consultation to operators and their consulting engineers relative to the extent of control needed and other factors relative to development of a pollution control plan and design of control facilities. Our regulations specify average minimum requirements for control facilities, but also provide for varying the requirements to the needs of the operation under consideration. Thus, control facilities and plans may propose less or more capacity for control works, as the need is deemed to warrant.

The regulations, in addition to requiring control facilities where needed, require a plan for operation of facilities. This plan must provide for suitable means for storing and disposal of accumulated "dry" wastes and sludges, and for the utilization of liquids for irrigation or disposal by other approved means.

Plans for the control of wastes, including facilities design and operating procedures, are submitted to the department for review and approval. Upon completion of facilities, a final inspection is made. If the constructed facilities and operational plans are approved, the department must issue a permit for the facilities before they can be put into use.

Permits may contain any limiting conditions deemed necessary and may be revoked on 30 days' notice, for cause.

CHAPTER 28. State Board of Health Regulations

Article 18. Agricultural and Related Wastes Control

28-18-1. Definitions

For purposes of the regulations in this article, the following words, terms and phrases are hereby defined as follows:

(a) The words "confined feeding" shall mean the confined feeding of animals for food, fur, or pleasure purposes in lots, pens, pools or ponds which are not normally used for raising crops and in which no vegetation, intended for animal food, is growing. This will not include a wintering operation for cows in lots or on farming ground unless the operation causes a pollution problem.

(b) The words "confined feeding operation" shall mean (1) any confined feeding of 300 or more cattle, swine, sheep, or horses at any one time, or (2) any animal feeding operation of less than 300 head using a lagoon, or (3) any other animal feeding operation having a water pollution potential, or (4) any other animal feeding operation whose operator elects to come under these regulations.

(c) The term "operator" shall mean an individual, a corporation, a group of individuals, joint venturers, a partnership, or any other business entity having charge or control of one or more confined feeding installations.

(d) "Food animals" shall mean fish, fowl, cattle, swine, and sheep.

(e) "Fur animals" shall mean any animal raised for its pelt.

(f) "Pleasure animals" shall mean dogs and horses.

(g) The words "waste retention lagoon" or "retention ponds" shall mean excavated or diked structures, or natural depressions provided for or used for the purpose of containing or detaining animal wastes consisting of body excrements, feed losses, litter, cooling waters, wash waters, whether separately or collectively, or any other associated materials detrimental to water quality or to public health, or to beneficial uses of the waters of the state. A waste retention structure shall not be construed to be a treatment facility and discharges of waste water therefrom shall not be allowed except as authorized by regulations 28-18-3 and 28-18-4.

(h) The words "waste treatment facilities" shall mean structures and/or devices which stabilize, or otherwise control pollutants so that after discharge of treated wastes, water pollution does not occur and the public health and the beneficial uses of the waters of the state are adequately protected.

(i) The words "water pollution control facilities" shall mean waste retention lagoons, retention ponds, or waste treatment facilities.

(j) The term "department" shall mean the Kansas State Department of Health. (Authorized by K.S.A. 82-164, K.S.A. 65-171f, K.S.A. 65-165 as amend., K.S.A. 65-167 as amend., K.S.A. 65-171d as amend., K.S.A. 65-171h as amend.; effective 31 May 1967.)

28-18-2. Registration and Water Pollution Control Facilities Permits.

(a) Effective July 1, 1967, the operator of any newly proposed confined feeding operation as defined in regulation 28-18-1(b) must register with the Kansas State Department of Health prior to construction and operation of the lot, pen, pool or pond. The operator of any existing confined feeding operation as defined in regulation 28-18-1(b) must register by January 1, 1968. Application for registration shall be made on a form supplied by the department.

(b) Applicants shall submit the completed application form to the department together with supplemental information regarding general features of topography, drainage course and identification of ultimate primary receiving streams. Additional information which may be deemed necessary for satisfactory evaluation of the application may be required by and shall be submitted to the department.

(c) If in the judgment of the department, a proposed or existing confined feeding operation does not constitute a potential water pollution problem because of location, topography, or other reasons, provision of water pollution control facilities will not be required.

(d) If in the opinion of the department a confined feeding operation does constitute a water pollution potential, or if water pollution occurs as a result of any confined feeding operation, the operator shall provide water pollution control facilities which shall be constructed in accordance with plans and specifications approved by the department.

(e) Water pollution control facilities shall not be placed in use until a permit has been issued. Permits for water pollution control facilities will be issued by the executive secretary of the Kansas

State Board of Health upon satisfactory completion of construction in accordance with plans and specifications approved by the department. Water pollution control facilities permits shall be revocable for cause on thirty days' written notice. If a water pollution control facilities permit is revoked, the owner or operator of the confined feeding operation involved shall be allowed to finish feeding existing animals in the lot, pen, pool or pond at the time of revocation but shall not place or allow to be placed in the lot, pen, pool or pond any other animals until the minimum requirements for water pollution control as set forth in regulations 28-18-3 and 28-18-4 have been met and a new water pollution control facilities permit has been issued. (Authorized by K.S.A. 65-164, K.S.A. 65-171f, K.S.A. 65-165 as amend., K.S.A. 65-166 as amend., K.S.A. 65-167 as amend., K.S.A. 65-171d as amend., K.S.A. 65-171h as amend.; effective 31 May 1967.)

28-18-3. Requirements for Facilities.

Water pollution control facilities required shall be kept at the minimum requirements stated in the following paragraphs; provided that when site topography, operating procedures, and other available information indicate that adequate water pollution control can be effected with less than the minimum requirements, the minimum requirements may be waived; provided further that if site topography, operating procedures, experience, and other available information indicate that more than the minimum requirements will be necessary to effect adequate water pollution control, additional control provisions may be required.

(a) CATTLE: The minimum water pollution control facilities for the confined feeding of cattle shall be retention ponds capable of containing three inches of surface runoff from the feedlot area, waste storage areas, and all other waste contributing areas. Diversion of surface drainage prior to contact with the confined feeding area or manure or sludge storage areas shall be permitted. Waste retained in detention ponds shall be disposed of as soon as practicable to insure adequate retention capacity for future needs.

(b) SWINE: Waste retention lagoons for swine feeding operations may be allowed in lieu of waste treatment facilities. Waste retention lagoons must be capable of retaining all animal excreta, litter, feed losses, cooling waters, wash waters, and any other associated materials and shall additionally be capable of retaining three inches of rainfall runoff from all contributing drainage areas. Diversion of surface drainage prior to contact with the confined feeding area or manure or sludge storage areas shall be permitted. Provision must be made for periodic removal of waste material from retention lagoons.

(c) SHEEP: The minimum water pollution control facilities for the confined feeding of sheep shall be retention ponds capable of containing three inches of surface runoff from the confined feeding area, waste storage areas, and all other waste contributing areas. Diversion of surface drainage prior to contact with the confined feeding area or manure or sludge storage areas shall be permitted. Waste retained in detention ponds shall be disposed of as soon as practicable to insure adequate retention capacity for future needs.

(d) OTHER ANIMALS: Each confined feeding operation registered involving other animals shall be evaluated on its own merits with regard to the water pollution control facilities required, if any. The confined feeding of other animals shall not cause or lead to the pollution of the waters of the state by runoff water from confined feeding areas, release or escape of water from pools or ponds, improper storage or disposal of waste materials removed from the confined feeding area, or by any other means.

(e) Waste treatment facilities shall be designed, constructed, and operated in conformance with the provisions of regulation 28-18-4. If waste treatment facilities consist only of pond or lagoon type structures, there shall be a minimum of two such structures for series operation.

(f) Other methods of water pollution control shall be permitted where in the judgment of the department effective results will be obtained. (Authorized by K.S.A. 65-164, K.S.A. 65-171f, K.S.A. 65-165 as amend., K.S.A. 65-166 as amend., K.S.A. 65-167 as amend., K.S.A. 65-171d as amend., K.S.A. 65-171h as amend.; effective 31 May 1967.)

28-18-4. Operation of Facilities.

(a) The water pollution control facilities shall be operated and maintained so as to prevent water pollution and to protect the public health and the beneficial uses of the waters of the state.

(b) Waste discharges from retention ponds, lagoons, or waste treatment facilities into any watercourse shall be in conformance with the water quality requirements of the appropriate river basin criteria as set forth in chapter 28, article 16 of regulations adopted by the Kansas State Board of Health and regulation 28-18-3.

(c) Waste materials removed from retention ponds, waste treatment facilities, and/or confined feeding areas shall be disposed of or stockpiled in a manner which will not contribute to water pollution. Wastes may be used for irrigation or spread on land surface and mixed with the soil in a manner which will prevent runoff of wastes. Other methods of disposal of wastes from retention ponds, retention lagoons, waste treatment facilities, and/or confined feeding areas shall be evaluated and permitted if in the judgment of the department effective water pollution control will be accomplished. (Authorized by K.S.A. 65-164, K.S.A. 65-171f, K.S.A. 65-165 as amend., K.S.A. 65-166 as amend., K.S.A. 65-167 as amend., K.S.A. 65-171d as amend., K.S.A. 65-171h as amend.; effective 31 May 1967.

Large cattle feedlots add to the potential pollution problems of the basin.

CONTROL DEVICES FOR ANIMAL FEEDLOT RUNOFF

Terry O'Brien, Public Health Engineer
T.A. Filipi, Secretary
Nebraska Water Pollution Control Council
State Department of Health

The confined feeding of livestock animals in large numbers has produced one of the most perplexing and complex problems ever faced by engineers, planners, and developers not to mention the livestock feeder himself. The problem increases solid waste disposal, stream pollution, and air pollution. Basically, it involves the controlling of wastes from the animals in the confined feeding operation.

There is a considerable amount of literature available concerning the characteristics of animal wastes. There is also a considerable range of values given to these characteristics, depending upon whose literature you are reading. It is important to remember that perhaps these characteristic values do vary considerably. It is understandable that the type of feed, amount of bulk, and other items will affect the waste characteristics.

The immediate concern here is, "what type of control devices or remedial measures can be used effectively to prevent these wastes from entering and polluting surface and underground waters". Several types of facilities have been used. For cattle, the primary type of facility considered has been the detention pond. For poultry and swine, there is a variety of systems. Anaerobic lagoons, facultative lagoons, aerated lagoons, aerobic lagoons, the oxidation ditch, and holding pits have been used with varying results.

The detention pond is simply a pond constructed to hold surface runoff water. Properly constructed, the only water entering the detention pond is the runoff from the feeding area. Surface drainage above and around the feedlot is diverted directly to natural drainage. The size of the detention pond depends on the area of the feedlot and the amount of surface runoff to be controlled. This is not to be confused with a stabilization lagoon. If a detention pond is to be used as a stabilization lagoon, then the amount of runoff will probably not be the critical factor in sizing the facility. The difference being that a detention pond retains the runoff for but a short duration prior to disposal. A stabilization lagoon is designed to give a certain degree of treatment to the wastewater prior to disposal. Consequently, a stabilization lagoon should be designed for a certain organic loading. Sizing a lagoon for the organic loading with this type of waste would almost surely give a larger size than using the hydraulic loading only.

Both the detention pond or the stabilization lagoon have serious drawbacks. For the detention pond to be successful, the water must be removed within a few days after it is collected. If it is not removed, it will turn black, septic, and become very odorous. Two heavy rains within a short period of time will cause the pond to overflow septic water. If you do remove the water quickly, what do you do with it? It is difficult, or perhaps impossible, to irrigate with it when the ground is wet and possibly already saturated. The stabilization lagoon must maintain a certain water level to function properly. During dry periods with no rain, auxiliary water must be supplied to maintain the desired water level. If it is designed for the organic loading, they will be very large. This uses up valuable land and increases maintenance problems.

Anaerobic lagoons have been tried as a system for animals waste on a small scale. The reduction of volatile solids appears satisfactory when loaded at a rate of 0.4 pounds of volatile solids per cubic foot per day. The effluent is still strong and requires additional treatment. Consequently, an aeration system and polishing lagoon were used prior to final disposal. The total system gave an overall BOD reduction of 97%.

It would seem that there could be major disadvantages to an anaerobic-aerated (activated sludge) type system as there would be with any biological treatment system. To function properly, any biological treatment system must receive raw wastes (food) at a fairly constant rate. This may not be too difficult to accomplish when working with swine or poultry since they can be confined and fed inside buildings. However, cattle are not, and runoff from rainfall or snow melt will carry most of the waste to the treatment system. This will come, of course, in surges and slugs. Under these conditions, the effectiveness of any biological system would be questionable. This would be particularly true with an anaerobic system or activated sludge system with their short detention time and high loading rate.

It would seem that the best answer at this time is the aerobic or possibly aerated lagoon preceded by a system for removing all the settleable solids. Animal wastes are apparently amenable to biological treatment with the exception of removing the color. One possible solution might be as shown in Figure 1. The idea being that to satisfactorily treat the runoff water biologically, the operator must maintain a biological system during non-runoff periods. To be successful the treatment system must receive raw waste (food) even when there is no runoff. This could be done by scraping the lots to a trough and hydraulically washing the waste to the system. This would have to be done at least twice a week. However, not all lots would have to be scraped twice a week. The water used to wash the waste to the system could be pumped from the last lagoon cell to the trough. Facilities should be available to add make-up or dilution water, if necessary. The first two cells would have aerators to be used when necessary after heavy runoff. These cells should also be designed to operate at variable depths, possible 10 feet during wet weather. This would provide storage for runoff until it can be treated. The solids sedimentation area would be shallow, possible concrete lined to permit mechanical loading of solids.

Once again economics may rule out this type of system; however, is there a satisfactory and economical solution? It is our opinion that irrigation may not be the answer. During a wet year when a feedlot operator has the maximum amount of water to dispose of, irrigation is not needed. The other alternatives are cover the lots or move the cattle inside buildings.

Several articles on animal feed wastes seem extremely concerned about the amount of time required to maintain a control system. A good system to be effective is going to require time and maintenance, or it will not be a good system. Animal waste management in the future will probably become one of the more important phases of confined animal feeding.

REFERENCE

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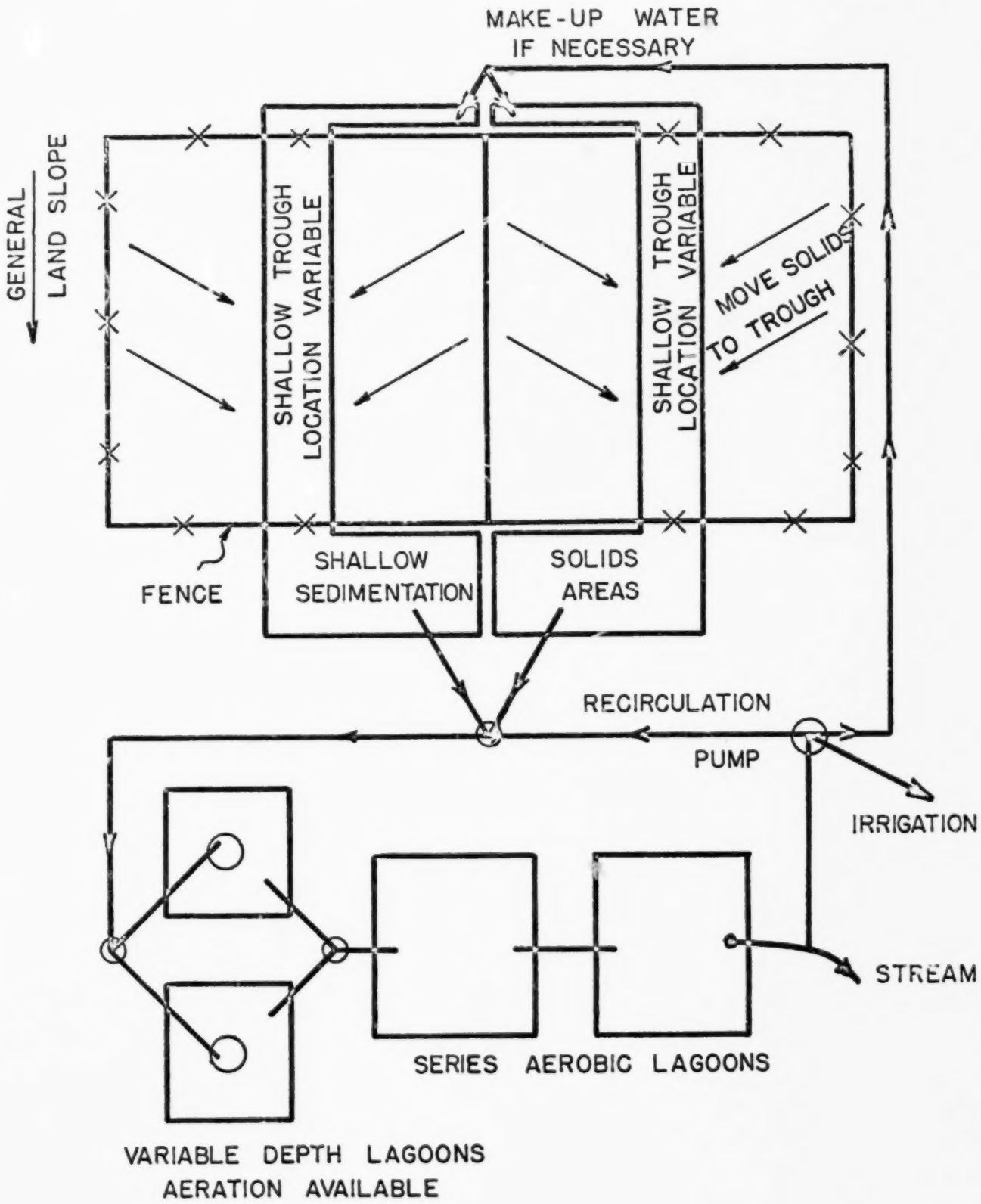
MAKE-UP WATER
IF NECESSARY
GENERAL
LAND SLOPE
SHALLOW TROUGH
LOCATION VARIABLE
SHALLOW TROUGH
LOCATION VARIABLE
MOVE SOLIDS
TO TROUGH
FENCE
SHALLOW
SEDIMENTATION
SOLIDS
AREAS
RECIRCULATION
PUMP
IRRIGATION
STREAM
SERIES AEROBIC LAGOONS
VARIABLE DEPTH LAGOONS
AERATION AVAILABLE

FIGURE 1

RESEARCH ON ABATEMENT OF POLLUTION AND MANAGEMENT OF ORGANIC WASTES FROM CATTLE FEEDLOTS IN NORTHEASTERN COLORADO AND EASTERN NEBRASKA

Dr. Chester E. Evans, Chief, Northern Plains Branch,
Soil and Water Conservation Research Division
Agricultural Research Service, USDA
Fort Collins, Colorado

Livestock produces a tremendous tonnage of wastes in the United States amounting to 1.6 billion tons in 1965. If one adds to this figure other associated waste materials such as bedding and carcasses, total production of animal wastes comes close to 2 billion tons a year. Other estimates place the production of animal manure in the U.S. at over 1 billion cubic yards a year. If this manure yardage were divided up equally, every family would receive 25 cubic yards a year as their fair share. This would be enough to fill the average 9 x 15 foot living room to a depth of 5 feet, or about chin level on most adults.

About three-fourths of our beef cattle are finished in feedlots. Some of these feedlots carry as many as 50,000 head. Such feedlots have the waste disposal problem that would be incurred by a city of 600,000 people.

Economic studies indicate that farmers cannot afford to haul manure to the field for its fertilizer value as compared to the economy of obtaining plant nutrients from commercial fertilizers. Economic and engineering problems of handling and disposing of vast quantities of animal wastes have indeed become a serious national problem.

Rains are very efficient in picking up particles from a feedlot, barnyard, or poultry disposal area. In fact, many feedlots are placed on slopes to improve runoff, and runoff water is usually heavily burdened. The organic matter so carried into the streams invariably has a high bio-chemical oxygen demand (BOD) and readily depletes dissolved oxygen in the stream under aerobic decomposition.

This oxygen deficiency can be sufficiently serious as to destroy aquatic life in streams, lakes, and ponds. Runoff from animal concentration areas carries nitrogen and phosphorus that in due course may promote eutrophication (nutrient enrichment) and resultant excessive algal growth in streams and lakes. It is therefore essential to use diversions or other runoff control measures to prevent animal wastes from entering streams. Feedlot management practices should be developed to minimize ground water pollution through deep percolation. There is an urgent need for agriculture to develop economically feasible systems to dispose of these wastes either in lagoons or on the land. Land disposal of manure wastes still offers a great incentive because it constitutes the perfect example of recycling organic materials and plant nutrients.

Cattle Feeding Industry in Colorado and Nebraska

Northeastern Colorado with an annual precipitation of 14 to 15 inches and eastern Nebraska with an annual precipitation of 27 to 28 inches, represent two contrasting climatic zones in which the cattle feeding industry is becoming a highly significant agricultural enterprise in the economy. For example, over 12 percent of the 10 million cattle on feed in the United States annually are in Nebraska feedlots. These feedlots are concentrated in eastern Nebraska in the Platte River Valley. Commercial transactions dealing with live cattle in the State total $1.5 billion annually. The total volume of business generated in the State by all aspects of beef production and processing amounts to $6 billion annually.

In Colorado most of the 625,000 cattle in feedlots as of February 1, 1967, were located in the South Platte River Valley in the northeastern part of the State.

A typical stocking rate on feedlots of northeastern Colorado and eastern Nebraska is 150 square feet of space for each animal. Each animal on feed excretes an average of 150 pounds of nitrogen per year. This rate amounts to more than 20 tons of nitrogen added to each acre of feedlot each year. This tremendous quantity of N added to a feedlot surface must be removed in one way or another — either as a gas into the atmosphere, as a nutrient in manure spread on agricultural lands, as a pollutant in runoff water, or as a contaminant of ground water. Dissipation of these bulk supplies of nitrogen into the atmosphere through the process of denitrification has considerable promise, provided that intermediate products such as ammonia, NO, or NO2 are not involved. Intermediates such as these cause offensive odors and pollute the air.

Research Studies Underway or Planned in Northeastern Colorado and Eastern Nebraska

In the past 3 years, we in the Soil and Water Conservation Research Division of the Agricultural Research Service, USDA, in cooperation with the Colorado and Nebraska Agricultural Experiment Stations, have reoriented our research effort at Fort Collins, Colorado, and Lincoln, Nebraska, toward problems of disposal of organic wastes from cattle feedlots and related research on ways and means of abating pollution of surface and underground water supplies. An interdisciplinary approach involving microbiologists, chemists, engineers, physicists, and soil scientists is being used in this research. Animal scientists and economists are available for consultation on our cooperators' staffs. Research pro-

jects either completed or underway include the following:

Fort Collins, Colorado:

1. Study of nitrate and other water pollutants under fields and feedlots in the South Platte River Valley of Colorado.
2. Laboratory model studies to determine the effect of feedlots on the quality of ground water.
3. Surface and ground water pollution from cattle feedlots.
4. Microbial aspects of commercial feedlots, animal manures, and fertilizers in relation to problems of soil and water pollution.
5. The value of farmyard manure as a nutrient source for plants.
6. Microbial versus chemical reduction of nitrate under feedlots in relation to the redox potential.
7. Movement of cattle urine through columns of soil.
8. Phosphorus equilibrium in dilute suspensions of significance in pollution of water by sediments.

Lincoln, Nebraska:

1. Evaluation of existing water and soil pollution and of factors affecting water and soil pollution from cattle feedlots.
2. Exploratory chemical and microbial studies of wastes in catchment basins and in soil profiles under newly established cattle feedlots at Mead, Nebraska.

Depending upon the availability of funds in the coming year, we plan to expand or initiate research in the following areas:

1. The extent and kinds of microbial, chemical, and organic pollutants entering the atmosphere, soils, and surface and underground water supplies from commercial feedlots.
2. To develop systems for controlling feedlot pollution through use of basin-type terraces on feedlots, water extraction systems for removal of free surface water from level and sloping feedlots, and treatment of runoff from feedlots by aeration and activated microflora and by precipitation of colloids.
3. Field investigations of the physical, chemical and microbiological effects of heavy manure applications on uncropped and cropped soils over a period of years.

Discussion of Research Results

I would like now to highlight some of our preliminary findings relative to nitrate and other water pollutants from cattle feedlots. In a study of nitrate and other water pullutants under fields and feedlots in the South Platte River Valley of Colorado, 129 cores representing nonirrigated fields in native grass, cultivated nonirrigated fields, irrigated fields in alfalfa, irrigated fields in crops other than alfalfa, and corrals were obtained in northeastern Colorado. Samples were taken at 1-foot intervals to the water table or bedrock.

The average total nitrate-nitrogen moving through soil profiles toward the ground water varied widely with land use, the amounts being alfalfa fields, 79; native grassland, 90; cultivated dryland, 261; irrigated fields not in alfalfa, 506; and feedlots, 1,436 pounds of nitrogen per acre to a depth of 20 feet. Although much larger amounts of nitrate are present under feedlots per unit area, irrigated fields probably contribute more total nitrate to the ground water because of their large acreage. Data indicated that 25 pounds per acre of nitrogen were lost annually to the water from irrigated fields. Ground water samples often contained high concentrations of nitrate, and those obtained beneath feedlots frequently contained ammonium and organic carbon.

Nitrate distribution data showed that, in general, corrals contained little nitrate in the top few inches, high amounts in the next several feet, and then rapidly decreasing amounts at the deeper depths. The reason for the lack of nitrate with increasing depth is probably the lack of oxygen, as indicated by the low redox values measured in many of the cores.

Data on bacteria and nitrite indicated that denitrification is occurring under feedlots at deep depths. There were considerably larger populations of bacteria in the corral cores, especially at the deeper depths. Below 15 feet, there were about 10 times more bacteria under the corral as compared to those present in the cores from the irrigated field. This is undoubtedly due to a high carbon supply under the corral.

We recently completed a laboratory study at Fort Collins to determine the effect that different management systems, primarily stocking rates, have on movement of feedlot pollutants to ground water. Preliminary data obtained from treating columns of soil with different rates of urine and water additions showed that movement of contaminants through soil columns were dependent on the management system. The only urine-treated column where there was not a substantial movement through the soil was a column that received less urine than there was evaporation of water from the column. In this case, all the contaminants were kept in the upper 6 inches of the column, and over 50 percent of the nitrogen added as urine was lost from the system as ammonia. Where urine additions exceeded evaporation losses, or if water was added in addition to urine, lesser amounts of nitrogen were lost as ammonia and larger amounts of contaminants moved through the soil.

In another study at Fort Collins, Colorado, we found that there was a rapid die-off of the coliform population in feedlot soils, given the usual animal stocking rates and the concomitant high ammonia concentrations arising from the urea excreted in the urine. The relatively short half-life of the coliform populations excreted in the feces, together with the failure to find any appreciable downward movement of the coliforms in the soil profile, indicates little danger of ground water contamination with coliforms of feedlot origin. Ammonia concentrations found in about half the total number of commercial feedlots examined were of the order of 1,000 ppm, a level shown to be strongly bacteriocidal to the nitrifying bacteria. The nitrification studies completed strongly suggest that feedlot stocking rates and corral management practices can be controlled to inhibit nitrification in feedlots, and thereby reduce nitrate enrichment of ground water. Evidence indicates that energy-rich organic materials in animal excreta are leached into and through the soil profile under feedlots, thereby causing greater growth of the indigenous soil bacteria in the deeper profile and in the ground water.

Recent laboratory studies at Fort Collins have shown that as much as 90 percent of the nitrogen in urine excreted in cattle feedlots may escape into the atmosphere as ammonia. Little is known about this loss of ammonia, or about how much of the ammonia volatilized from feedlots might be absorbed from the air by nearby agricultural soils, crop canopies, or water surfaces. Measurements of ammonia absorption by water surfaces have indicated that movement of ammonia through the atmosphere might represent an important mechanism for transfer of nitrogen from feedlots to the surrounding environment. At a site about 0.3 mile distant from a large feedlot, the rate of ammonia absorption was found to be about 20 times that at a dryland control site, and reached as high as 3.6 pounds of nitrogen as ammonia absorbed per acre of water surface per week. Even at a distance of 1.2 miles from the feedlot, the rate of ammonia absorption averaged over ½ pound of nitrogen per acre per week, or 8 to 10 times the control. Measurement of ammonia in rain and snow showed that the amount of nitrogen as ammonia brought down from the precipitation is insignificant compared to that absorbed directly from the air by water surfaces. It is expected

that these data will upset some of the prevailing concepts that only runoff and deep percolation from feedlots need be controlled to prevent eutrophication of surface waters and may have a substantial influence on the criteria for adequate design of feedlots.

In eastern Nebraska, beef cattle feedlots are being studied on two farms to assess pollution potentials and management of wastes on lots. One is a level site (T. C. Reeves, feeder) on a sandy soil with a water table at 9-10 feet at Central City, Nebraska. The second is on a sloping, loess hill site (Howard Krambeck, feeder) near Gretna, Nebraska. Early results from 1968 indicate that runoff may occur on a sloping feedlot from a rain in excess of ½ inch. For eastern Nebraska, it is estimated that about 1 foot of runoff per year will occur on a sloping feedlot site. After initial wetting, the intake rates of the manure pack on the lot surface are very low. Runoff ranged from 10 percent to nearly 100 percent for individual rainstorms received on the 6-percent slope from September through October 1968.

Simulated rainfall was applied to 8 and 12 percent slopes on the Underwood Farm Feedlots near Omaha. Intake prior to runoff from a 2½-inch per hour intensity initial storm varied from 0.3 to 0.7 inch with a mean of 0.5 inch. Runoff from the 1-hour duration storm varied from 54 percent to 83 percent. The solids removed in runoff range from 0.4 ton per acre to 8 tons per acre. A second storm of 5-inch-per-hour intensity and 0.3-hour duration increased the average rate of removal of solids five fold.

Soil profile samples from the two Nebraska sites contain nitrates and ammonia in concentrations ranging from 0 to as high as 248 ppm. Ground water under the two feedlots at times contained nitrates in excess of 10 ppm in samples obtained at the soil-water interface.

In laboratory studies at Lincoln, manure from beef cattle with a high roughage diet was incubated in constant temperature chambers, where spring and summer climatic conditions at Lincoln, Nebraska, were simulated. Urine was added twice weekly to the incubated manure samples equivalent to stocking intensities of 50 and 250 square feet per animal. After 3 weeks of decomposition, 90 percent of the nitrogen added initially in the manure or in subsequent additions of urine was lost into the atmosphere with a stocking rate of 50 square feet per animal. In the decomposing manure, high concentrations of NO_3 occurred, the pH ranged from about 8 to 9, nitrate accumulated only to a slight extent, COD values remained high, and salt concentrations increased. About 50 percent of the volatile solids were lost in 4 months.

Summary

The Soil and Water Conservation Research Division of the Agricultural Research Service, USDA, in cooperation with the Colorado and Nebraska Agricultural Experiment Stations, has research underway at Fort Collins, Colorado, and Lincoln, Nebraska, on organic waste disposal and pollution problems of cattle feedlots. Extensive cattle feeding enterprises giving rise to critical waste disposal and possible water pollution problems are concentrated in northeastern Colorado and eastern Nebraska. The two contrasting climatic zones represented by the two locations present conditions that require special practices for managing feedlots to avoid pollution in runoff and underground waters, soils, and air. Research projects dealing with these problems and examples of some of the preliminary findings obtained are discussed.

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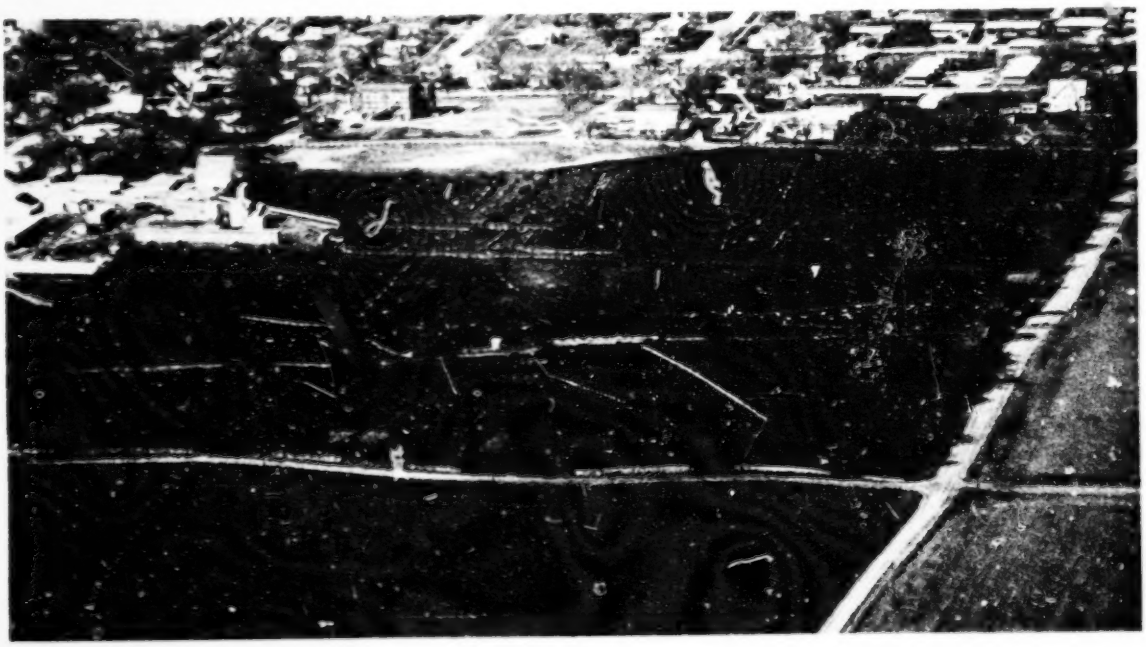


THE UNIVERSITIES' ROLE IN FEEDLOT POLLUTION CONTROL

Dr. J. Ronald Miner, Assistant Professor of Agricultural Engineering
Iowa State University, Ames, Iowa

The modern university is a many faceted organization capable of providing a great variety of services. To be effective, it must remain responsive to the needs of the day and, at the same time, maintain sufficient vision to identify problems of the future. This requires a great diversity of specialists among staff, as well as an administrative organization that promotes the cooperation of several disciplines on a single complex problem. The specific contributions of universities to the feedlot pollution problem can best be understood as we examine university activities in teaching, extension, research and consultation.

Teaching

One of the principal contributions of universities toward solving the feedlot-pollution problem has come through students. Today, university students are interested in the problems of the times, particularly those that would threaten the stability and quality of the world in which they will live. This interest is utilized as stimulation in the teaching of basic scientific principles and demonstration of their applications.

Courses dealing with various aspects of feedlot-runoff pollution are commonplace in departments of Civil and Agricultural Engineering as well as of Agronomy, Animal Science, Microbiology, Chemistry and Economics. Specific courses devoted to the management of livestock wastes have recently been added at various universities, including Iowa State. In these courses, the basic principles of other scientific disciplines are combined to guide the student in meeting the unique challenges of animal waste disposal. Thus, upon graduation, these students are prepared to make a real contribution toward solving specific pollution problems.

Seminars, guest lecturers, and special problems within the teaching program of the university provide significant opportunities for students to be made aware of feedlot runoff problems. During the past year, the increased awareness of these problems has stimulated interest in the use of these mechanisms.

Extension

The conviction that all people should have access to the ideas and knowledge of the campus has led to major extension activities related to most state universities. Extension programs afford the University a unique opportunity to assist and advise the farmers and industrialists of a state. This opportunity has grown out of the trust earned and preserved by extension personnel as sources of reliable, fair, and objective information presented at appropriate levels for different audiences. This confidence must be preserved.

Extension programs are for the purpose of education - increasing understanding of facts, new knowledge, and their applications. Thus, extension education can be one effective method of alerting feedlot operators to the problems of feedlot runoff and bringing to them the currently available means of controlling or abating these problems. Extension programs are not designed to promote specific interests nor to "sell" a particular position or approach. Thus, extension programs cannot be used to formulate agricultural policy nor to gain support for a particular political scheme for the control of pollution problems. But they can and should provide factual and objective information upon which decisions can be based.

Extension personnel also have a unique opportunity to bring information back to the university from the feedlot operators. This information as to the response of feeders to proposed pollution control programs can be invaluable in predicting acceptance of future programs and restrictions.

In Iowa, the extension voice has been heard in advising cattle feeders of the pollution problems they face and in helping them to develop reasonable solutions. Various media have been used: radio and television spots, county meetings, area short courses, cattle feeders' days and a multitude of individual conversations and conferences. These are being effective in developing an alert and well-informed core of cattle feeders who are working on ways in which they can meet their responsbilities. This does not mean these men will accept whatever restrictions are imposed upon them without any reaction, nor should it. The goal must be an informed response.

Research

The modern university is rapidly becoming known as a center for research as well as for the training of students. These roles are not conflicting and have been mutually beneficial. Research activity has been stimulatory to faculty members and has drawn them into the center of current scientific activity. This brought new insights and relevance into classroom teaching. Students, in turn, have contributed to the research program by providing a source of alert and ambitious scientific manpower.

Universities have been successful in research, not only because of the capabilities of individual researchers, but also because of the pool of talents existing within the bounds of a major campus. The feedlot runoff problem has drawn the attention of sanitary, agricultural, and chemical engineers as well as of hydrologists, economists, and bacteriologists. This list is not complete, but it does indicate the variety of expertise brought to bear on a single topic.

A well-designed research project must have considered several criteria. It must, first of all, be of interest to one or more researchers within the particular university in question. It must further be compatible with facilities at the disposal of the researcher or with facilities that can be provided. It should be a project that will stimulate growth on the part of the scientist and allow him to provide training to students with whom he will work. Thus, it should be related to both his area of expertise and the area of competence of his students. Finally, some source of funding must be available for the project, either within the university or tied directly to the project.

Research related to feedlot runoff has met these criteria at some institutions, and at others, it has not. The construction and operation of cattle feedlots specifically for runoff studies has presented a number of difficulties.

A project of this type immediately requires the close cooperation of two or more departments, thus the interest and willingness of two or more researchers who may have never worked together previously. Unless it is possible to utilize an existing feedlot or to design a multiple use facility (e.g., one for feeding trials), the financing of the runoff project must include construction funds. Where multiple uses are to be made of a facility, conflicts such as feeding programs, animal densities, and lot management must be resolved.

Frequently, it is desirable to establish long-term research or demonstration waste-management systems. Land-Grant Universities, with their associated teaching and research centers or demonstration farms, offer special opportunities along these lines. Whenever additions or modifications are made at these sites, it is possible to incorporate the most recent developments in waste handling and runoff control. The primary limitations to the waste-management system must be compatible with the research program of the station. Where management of the waste handling facilities are entrusted to the operating personnel of the station, the required management must be no more demanding than the previous system. Frequent adjustments or repair of equipment is not reasonable to expect.

Indeed, the research of universities does have a role in feedlot runoff control. This activity is accelerating as is evidenced by the increasing number of universities instituting feedlot runoff projects. So long as these projects are well planned and the right questions are asked, progress will be made. But when researchers or others attempt to answer questions beyond their competencies, confusion is likely to result.

University research has identified the characteristics of feedlot runoff, its hazards and its variability. Treatment schemes have been studied which are capable of removing many of the objectionable constituents. They have not, however, solved the pollution problems. These schemes do not provide the economic nor social incentive for their application. The solutions are in addition incomplete; more numerous as well as more complete alternatives are needed. Systems are needed which will assure both the feeder and the public that the water resources will be protected and that the feeder can live amicably in his community without the fear of further expense.

Consultation

One of the ways in which a university interacts with society is through consultations of its staff with various individuals and agencies. Such conferences are specific avenues for utilizing the training, experience, and hopefully, the creativity of university teachers, researchers, and administrators to the solution of specific problems or the formulation of policy. Such interactions, not only allow faculty members to utilize their expertise in a meaningful way, but also encourage their professional growth and development.

In Iowa, consultations between university personnel and cattle feeders or cattle-feeder associations, as well as between university personnel and regulatory agency officials, have been fruitful in feedlot pollution control. The design of runoff control facilities for several of the major feedlots has been based on the counsel and advice of university people. Extension agricultural engineers with an overall familiarity with cattle feedlot design have been particularly effective in this role. Their combination of training in drainage design, feed handling systems, overall system layouts, water systems, and structural design have made them invaluable sources of information. Conferences with cattle feeders, neighbors and, on occasion, with their attorneys as to possible solutions to specific problems or complaints have also been important. Although not always successful, these conferences have been possible because of the university's reputation as an unbiased source of objective recommendations.

University personnel in Iowa were invited to serve on an advisory committee to the Iowa Water Pollution Control Commission. Their assignment was first, to prepare a report on the importance of livestock manures relative to water pollution and, later, to formulate a proposed regulatory scheme for cattle feedlot runoff. This proposal was accepted by the Commission and presented by them as Proposed Feedlot Regulations.

Future Role

Until feedlot runoff control is achieved in a manner acceptable to the livestock producer, regulatory agencies and the general public, the universities must play an active role. Research must continue as must the various aspects of teaching - classroom, extension and consulting. In addition to solving the immediate problem of keeping polluted runoff out of watercourses, university research, first, and, later, teaching, must concern themselves with the secondary problems associated with feedlots and pollution. Among these secondary, but critical, questions associated with feedlot runoff are: runoff utilization, nutrient recovery, odor, and dust control as well as the treatment of impounded runoff water.

HOW TO GAIN PUBLIC SUPPORT

Roderick Turnbull, Agricultural Editor
The Kansas City Star

I am the one man on this panel who doesn't have a manuscript for the simple reason that I didn't know what I was going to say. They gave me the title of "How to Gain Public Support" and until I had the opportunity to hear what was being talked about this morning, I didn't know for sure what we were to gain public support for. I didn't know whether the public support we were to talk about was to be gained from farmers who would be actually involved in a pollution control program or from the public which would be putting the pressure on these farmers. I'm pretty sure now that this program we are talking about needs a little of both.

The Drovers Journal

News in Brief

Hearing on Hog Cholera Vaccine Called April 15

Top Young Farmers Are Cream of 10-State Crop

Chicken Hot Dogs Proposed

Common Sense Pays Off

Export Potentials Big for U.S. Beef

I'm often asked, as a newspaperman, how do you get public support for anything? I think I have some experience in this line. One way is to level with the public and be practical. You tell people the honest truth and don't try to sell them a bill of goods about something you want to promote.

It will be difficult to sell a bill of goods to farmers and cattlemen in particular. The farmer has become a far more sophisticated individual than before and the cattleman is noted as an individualist. He's the one man in

the farming business who wears the clothes to advertise his profession. He wouldn't be caught dead without his western hat. He's proud of being a cattleman.

These are the kind of men you are talking about when you are on the subject of water pollution from feedlots. They'll play fair, but they won't be pushed around.

From the public in general, you always get two extremes. In the pollution situation, you have those do-gooders who would stop doing anything that might in any way pollute streams — they'd halt the use of commercial fertilizer and anything else. If you argued they'd starve, they'd say so be it. On the other hand, there are some cattlemen and others who will insist they always have and will continue to do as they please on their own land.

Between these extremes are those people, both cattlemen and people in general, who will be reasonable if they are given the facts.

The facts in the present situation consist mainly of numbers, in my opinion. We finally have so many cattle and other livestock in feedlots that we have a problem — the water finally is running over the dam, so to speak. Once upon a time it wasn't a problem — there were not so many cattle nor so many people. Its hard for those of us who write about agriculture to realize that the number of cattle on feed has doubled since 1950.

These numbers as simply as anything define the problem. This is something I think the public can understand. When they do understand this, they'll be better prepared to give public support for whatever is needed to solve the problem. And just exactly what is needed — well, that is for others here to say.

MINNESOTA FEEDLOT POLLUTION CONTROL PROGRAM - STATUS REPORT

John P. Badalich

Thank you, Blaine. I was just making an observation, Blaine by the order we were called up to the podium, I was beginning to think that maybe this is also the order of the magnitude of the problems and that we have very little problems in Minnesota. I hope that is right. Gentlemen and ladies, I guess there are a few here, we in Minnesota are well aware of the feedlot problem and have been for many years, but I think because of other pressing problems, such as municipal treatment and industrial treatment needs, we probably just let the feedlot situation slide by until our attention was brought to this matter just recently. As I indicated to you this morning, by the Big Stone Lake study, which by the way was a joint venture between the Governors of Minnesota and South Dakota to try to solve the problem of eutrophication or the aging of this large body of water we have in the western part of the state, where approximately 24 nutrients entering the lake were from cattle feedlots, based on the limited survey we made, as I described this morning. Following this survey, monies became the problem in implementing treatment controls of the wastes entering the lake and also in trying to make the same type of inventory of the state.

The Agency is charged under statute, for the control of all wastes, which by definition states "other wastes". This we felt provided us the authority to classify feedlots under this category of "other wastes". We then proceeded to draft a preliminary regulation regarding feedlot controls which was distributed to the public and so noted as a "preliminary draft" on February 16, 1968. When this regulation hit the public, through the solicited help of the Soil Conservation Service who distributed this draft to the farm agents and the county agents throughout the state, I didn't know feedlots were such a great problem. I received criticism, in fact, slanderous remarks, on what we were doing, picking on the agricultural interests. Well, at least by this regulation going out and for discussion purposes only, a considerable amount of interest was generated in that the regulation as set forth was very, very restrictive. In fact, I would like to read the part that describes the feedlot - a feedlot shall mean a place of confined feeding of livestock or other animals for food, pleasure, or resale purposes in yards, lots, hence buildings, or other areas, not normally used for pasture or crops, in which substantial amounts of manure or related other wastes may originate by reason of such feeding of animals. This would mean that a fellow with one cow or one chicken was certainly going to be regulated even though this wasn't our intention, as we wanted to get the reaction from the people and this certainly was brought forth. In another part of this regulation we also indicated that every manure pile must have some type of a safeguard around it and this was described as probably a continuous dike or wall or other containment, so you see that this was quite a restriction. By this regulation going out, we were able to generate discussion between the Soil Conservation Service, the Department of Agriculture, the University of Minnesota Extension Service, the Department of Agriculture, the University of Minnesota Extension Service, the Minnesota Association of Commerce and Industry and also with the livestock industry itself. Following this discussion, we held several symposiums at the University of Minnesota studying the feedlot problem and I believe that after we get in all the reports and comments from these individual groups interested, we will sit down in a committee and propose standards and regulations that will be reasonable and desirable. This we intend to do in the very near future.

Probably an interesting sidelight of this and being that our legislature is now in session, I was called upon to appear in front of the Senate Agriculture Committee, which is primarily composed of farmers and the people in the industry, and as I brought forth and discussed this regulation, I thought I wasn't going to get out of there without any bloodshed. They felt that agriculture was not a polluter and that I should confine my interest in municipalities and industry. After explaining the feedlot problem to them and the potential problems that we are going to be faced with from agriculture, I think these people were very reasonable and feel that something is really necessary.

Following the setting up of reason-

able feedlot regulations, we then have to go through the statutory procedure of public hearings. This we will do and we will probably hold these hearings on a state-wide basis in five or six locations. At these hearings we hope to get the reaction of the people in industry as well as the public at large. Following this procedure, the next step is for our assistant attorney general to come up with the findings of fact, conclusions and order. The staff will also make recommendations to our Agency board. The Agency will then promulgate the standards, have them published and issued. Following this we will then set up the specific rules, regulations and procedures which I outlined for you briefly this morning. Next we will probably go into the inventory type procedure that I also outlined this morning.

We still feel, and this is one of our charges in the statutes, that any regulation or standard proposed to the public or any industrial or municipal group, must be reasonable, must be feasible and must also be practicable under the circumstance and we always strive to do this in Minnesota.

Thank you.

STATUS, PLANS, & NEEDS FOR A COMPREHENSIVE FEEDLOT POLLUTION CONTROL PROGRAM IN SOUTH DAKOTA

Blaine Barker, Chief
Water Pollution Control Section
South Dakota State Department of Health

The South Dakota Committee on Water Pollution recognized the problems associated with confined feeding of livestock and included a provision for promulgation of regulations to control wastes from these operations in the Plan of Implementation of the "Water Quality Standards for the Surface Waters of South Dakota". The Water Quality Standards were prepared during the summer and fall of 1966 and were adopted as official rules and regulations by the South Dakota Committee on Water Pollution on April 20, 1967. The Standards were approved by the Secretary of the U.S. Department of the Interior on August 7, 1967.

In January, 1967, an Advisory Committee to the Committee on Water Pollution and the State Department of Health was formed to provide technical assistance in developing regulations. In February, 1967, an inventory of livestock feeding operations was made by the County Agents. The following data resulted from the survey:

Size of Feedlots	Number of Feedlots		
	Cattle	Swine	
Less than 100 head	12,109	10,314	
100 - 299 head	2,629	5,737	
300 - 499 head	596	1,560	
Total 499 or less head	15,334	17,611	
Grand Total			32,945
500 - 1,000 head	202	3?3	
More than 1,000 head	101	72	
Total 500 or more head	303	405	
Grand Total			708
Lots less than 1,000 feet from stream or lake, regardless of size	628	691	

As of January 1, 1968, there were 4,323,000 cattle and calves on South Dakota farms and ranches with 406,000 of these cattle and calves on feed. The State has had a steady increase in the number of animals over the years.

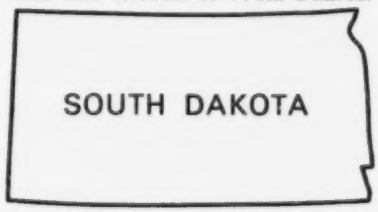
The Advisory Committee; representing South Dakota State University, the Livestock Sanitary Board, and the South Dakota Livestock Feeders Association; has met ten times in the past two years to consider the need for and implementation of a program of this kind. Proposed regulations were prepared by State Department of Health personnel for the Water Pollution Committee, based on suggestions from the Advisory Committee, the Livestock Feeders Association, and the South Dakota Attorney General's Office. The proposed regulations have been discussed at meetings of the South Dakota Livestock Feeders Association; the Sanitation Committee of the Livestock Feeders Association; the South Dakota Stockgrowers Association; and at two meetings of the South Dakota Committee on Water Pollution at which representatives of the livestock industry were present.

On December 9, 1968, a public meeting was held in Pierre regarding the proposed regulations. The meeting was attended by 55 persons, and many presented their views for and against the regulation.

Plans & Needs

The Committee on Water Pollution will review feedlot waste disposal including information presented at the December meeting and, will prepare a regulation for the purpose of holding public hearings.

At the December meeting, several comments were made as to the effect of discharge of these wastes into the lakes and streams of South Dakota.



Our staff does not have documented proof of pollution; however, we have access to data from other states and have observed wastes discharging from feedlot operations into surface waters, noting the effect of high organic loads on stream conditions. At the present time, we are working with the South Dakota Water Resources Institute and Civil Engineering staff at South Dakota State University, Brookings, in developing a study on the effects of these wastes on our surface waters.

A comprehensive study is to be made of the James River Basin, hopefully with assistance from FWPCA. Particular attention will be given to feedlot waste discharges, but the study will also include the sources of wastes, quantity and frequency of waste discharges, the effect of discharges on the stream, methods by which these wastes can be controlled, and subsequent upgrading of the quality of the water in the stream. This study should be completed prior to the introduction of irrigation return flows to the river to obtain pre-irrigation water quality data.

Our plans also include an education program to keep the industry informed of our proposals and obtain feedback from the agricultural community.

STATUS REPORT OF MONTANA'S PROGRAM TO CONTROL POLLUTION FROM ANIMAL FEEDLOTS

Don Willems, Chief
Water Pollution Control Section
Montana State Department of Health

Montana does not have feedlot regulations but at this time we are developing regulations. In reviewing our existing laws, we thought it was desirable to have a specific law for feedlots, both from the water pollution control and from the nuisance standpoints. Such a law was introduced at our present legislature but I understand that it has been defeated. Our existing water pollution control law gives us adequate authority and we believe that we also have authority in our clean air act to prevent air pollution from the feedlot, although, in the wording it is not too clear. We feel that control of both are needed in the regulation. The control of water pollution can lead to a greater air pollution potential. Actually, most of the complaints that we receive on feedlots are because of nuisance conditions.

We have an existing permit system for municipal and industrial waste discharges. We hope to develop a permit system under similar regulations

for feedlots. Initially, we plan to apply the permits to new and expanding feedlots and later to existing feedlots. I feel that we can get into a lot of neighborhood squabbles on existing feedlots if we do not proceed with caution. I recently investigated two complaints we had received on feedlots. One a neighbor was complaining of odors and the temperature at that time was 25 below zero. I did not think the complaint was too valid. Perhaps, it will be in the Spring. The second, a neighbor had also complained but the owner had moved his cattle out six months previously and had since thoroughly cleaned the feedlot. Again, no pollution.

However, we have the other extreme. One example is a town of about 1,000 population which has a feedlot of several thousand cattle and an egg producer with over 100,000 chickens, immediately bordering the municipality. This town has a legitimate complaint. Unless we are careful, it looks to me that we can spend much time on feedlots, while accomplishing very little. Our main concern at this time is to have adequate control of new feedlots and the prediction is that we'll have many in our State before too long.

MISSOURI'S ANIMAL WASTE MANAGEMENT

Bill Crockett, Water Pollution Control Engineer
Missouri Water Pollution Board

Agricultural wastewaters are believed to be detrimental to the quality of the waters of Missouri. The extent of water quality degradation is unknown. The Missouri Water Pollution Board believes the agricultural pollution in Missouri can be controlled through a program of education at this time. Specific legislation may be necessary at a later date. The Board is cooperating with the University of Missouri Extension Service and the Federal and State Departments of Agriculture to educate the farming public for the control of agricultural pollution. The staff of the Board will act in a consultant capacity to these agencies, the individual agency will conduct the actual training and/or educational programs.

In May 1968, the University of Missouri Extension Service completed a revised agricultural inventory for the Board on the stream basins of Missouri. The plans are to update the inventory every 3 years. It included all major basins of the State. This inventory contains land use data, fertilizer and pesticide usage data, as well as animal and poultry production data for each basin. From this inventory we will be able to study those basins which contain the largest concentration of livestock, to study the basins in which the feeders are located, and thus predict the potential stream pollution locations in the State.

It is thought by some in the cattle feeding industry that legislation for the control and/or registration of cattle feeders should be enacted in Missouri. It is possible that such legislation will be introduced in the Session of the Legislature. The Missouri Water Pollution Board does not plan to request legislation pertaining to the registration of feeders and/or confiners at this time.

STATUS REPORT - KANSAS FEEDLOT POLLUTION CONTROL PROGRAM - EXTEMPORANEOUS REMARKS

Melville W. Gray, Assistant Director, Environmental Health Services
Kansas State Department of Health

I would dislike seeing anyone in this audience today leave with the impression that the State of Kansas rushed into the adoption of regulations for animal feeding operations rather hastily. In a quick review of what was said this morning and in relating to you our intent, plans, and the progress we are making in the control of animal wastes, I want to state briefly that our problem did not start yesterday. Our problem started in 1958 and it took approximately 10 years to reach conclusions which we felt were going to provide a desirable degree of protection from the standpoint of water quality control. Neither have we ignored the air pollution aspects or nuisance aspects of large feeding installations.

Approximately five years ago we did enter into contractual arrangements with Kansas State University and the University of Kansas for the development of not only laboratory projects but field scale projects involving feedlots, from the standpoint of water pollution control. I wish to emphasize that what has been concluded to be appropriate for Kansas may not be appropriate for Colorado or any of the other states because of the varying hydrologic conditions. Therefore, we have developed our regulations based on conditions in Kansas as they exist on each specific feedlot, and the requirements are variable in each instance dependent on topography, rainfall, and all inherent areal factors both existing and proposed.

As a result of the research at our Universities, it was concluded that the activated sludge type of treatment is not feasible from an economic standpoint. From a practical standpoint, as it applies to our large feedlots, what we can expect of a feedlot operator in terms of all forms of pollution control is directly proportional to what you're willing to pay for a pound of steak. Therefore, we did conclude that retention ponds and the use of retained wastes for agricultural purposes was the key to our solution in Kansas. I would say also that three inches of retention as quoted is not a magic number. It varies considerably and at the present time we have designed control facilities with capabilities of retaining from 0 to 6 or 7 inches of runoff, dependent upon where they are located and the probability of rainfall and runoff conditions. As was pointed out by Dr. Evans, rainfall and runoff ratios will vary dependent upon the intensity, topography, and soils. We give no credence to runoff occurring from rainfall of less than ½ inch, but you will obtain runoff factors approaching unity for a high intensity rainfall where you receive 5 or 6 inches of rainfall in a 24-hour period.

I would say also that we do have a proven product in terms of the effectiveness of our control program. Less than three months ago one of our completed projects, which are few at the present time, received six inches of rain in approximately a 24-hour period. Not one drop of pollution material

reached the nearby receiving stream and yet in years past at the same feedlot, we have had considerable outcry from the populace of fishermen and fish and game officials whenever we received one or more inches of rain.

We have not approached our problem by a single effort on the part of a single agency. Although final authority for pollution control rests with the Department of Health, our problems are approached with the livestock sanitary commissioner's office, the agricultural extension service, the county agent, the consulting engineer, and the feeder. This program goes beyond a mere application of conventional engineering principles. The agricultural engineering aspects of this program are an integral part. We are taking a waste product and we believe we are making an asset of this waste product in terms of our economy. The same nutrient materials that can cause trouble in our streams and reservoirs by the over-abundant production of plant life, is also applicable to the production of agricultural crops. One hundred eighty-five bushels of corn in Kansas is still a pretty good corn crop, and this is what we have been able to produce by the application of these wastes to agricultural land.

We are *not* seriously concerned from the standpoint of ground water pollution by way of the feedlot surface or from retention facilities. The amount of nitrate or other contaminants which might find their way into the ground water table is insignificant when compared to the overall agricultural community in the application of commercial fertilizers if this in fact is a problem.

We are more concerned with the solid waste material, the manures that are cleaned from the feedlot surface, and reapplied to agricultural land. This, too, must be done with intelligence. Application rates of 300 tons to the acre of these manures may be appropriate in the event of recently leveled land, where the topsoil has been removed, but are not appropriate for agricultural land which is in continuous production of crops. The amount of nutrients that can be applied per acre is directly proportional to that which will be removed with the crop grown. Application rates to land is an integral part of our approach as it relates to ground water.

Again, with respect to rushing into a program, we do not anticipate that we're going to have all of our lots covered within the next week, the next year, perhaps the next five years because results are directly proportional to input. We have 13,500 cattle feedlots in Kansas as listed on the display map. You can add to that approximately 10,000 hog farmers, 7,500 dairy farming operations, and quite frankly we have enough problems right now with conventional municipal and industrial waste treatment plants that number some 800 separate installations. We must obtain the cooperation and the understanding of the animal feeding community. This is essential to our program. You have heard it said that you cannot force an individual to do anything and in closing I would leave this thought with you - not too long ago, I heard one of the coaches from the University of Kansas football team indicate that once in a while they had a football player on a scholarship who was getting a little bit lazy, not quite putting out with the endeavor they wanted from their team members. All you have to do is keep them away from the training table for a few days and it provides incentive. We look at our regulations as the incentive. We strive for endeavoring cooperation - we do have the incentive. Thank you.

STATUS REPORT - NEBRASKA FEEDLOT POLLUTION CONTROL PROGRAM

T.A. Filipi

Nebraska is proud of the Water Pollution Control activities that have been accomplished to date, because we have over 500 municipal and industrial waste water treating plants. Many of these were constructed under handicaps such as: difficulty in financing, inopportune time for construction, and uncertainty as to the loads to be treated. When stressing the need of waste water treatment to municipal officials, on many occasions they drew to our attention the fact that they are being asked to construct waste water treating facilities for a small amount of waste water when a large feedlot adjacent to the community is draining into the same stream into which they discharge their wastes. The amount of water, and especially the amount of solids from the feedlot, far exceeded any peak flow of the municipalities.

Furthermore, they indicated that there was no concerted effort to abate this feedlot pollution and, of course, questioned why we should be pointing ou. only one segment of pollutants.

We are proud of the accomplishment that we now have waste water treatment on all but six municipal outlets. These have all been given orders from the Water Pollution Control Council for treatment and plans are underway for complying with the directive.

It has been publicized that now municipalities and industries have taken care of their responsibilities and other polluters must follow in the program. Water Quality Standards have been adopted and are well-known to all persons in the State of Nebraska. Furthermore we are living in a new environment continuously. Therefore, programs will change from time to time and additional treatment will be demanded of those present plants, and treatment will have to be provided for those discharges that are now without treatment.

The problem of pollution from the industry of agriculture, specifically feedlots, was brought to the attention of the Nebraska Water Pollution Control Council by persons living downstream from the feedlots. They brought in evidence such as samples of water and photographs which clearly convinced the Council that serious pollution does occur and corrective steps must be taken.

The Water Pollution Control Council enjoys the cooperation and sympathetic attitude from various persons in the State, be they municipal officials, industrial representatives, agricultural interests, and the citizens. In the past, great progress was made through conferences, meetings, and

hearings. Therefore, through the cooperation of the University of Nebraska Extension Division, the Feedlot Operators Committee was formed representing all interests of this industry which included private and industrial feeders of swine, sheep, poultry, cattle, dairy interests, feed manufacturers, representatives of the University, and the Nebraska Water Pollution Control Council. It was amazing how much interest was shown by each of these representatives. They all realized that a problem exists and that a solution must be realized if they are to remain in business and especially be "good neighbors".

The first assignment that they assumed was to prepare rules and regulations relating to the registration of feedlots. Not until a survey had been realized to indicate the location and size of the lots could any corrective measures be taken. This was done on a voluntary basis and the results are now on file. It is estimated that a better than 80 percent of compliance of voluntary registration has been realized.

Local feedlot committees, county extension agents, and even civic organizations asked that speakers be provided to explain the problem of feedlot wastes, the program that is being considered, and what service from industry and the public can be realized. This, I stress, was all done on a voluntary basis with a result that we now have a registration of about 1800 operations involving about one million feeder cattle, 20,000 beef cows, 5,000 dairy cows, 225,000 swine, 75,000 sheep, several turkey and chicken farms. The wastes from these animals and fowl makes one shudder when stream pollution and water quality standards are being conside.ed.

The next assignment of the committee is development of a solution. We all realize that there is a problem. We all realize that corrective measures could be realized if the cost were forgotten, but like everything else the operational costs of feeding cattle is reflected in the price. Therefore, corrective measures must be within the economic possibility of the industry.

Research is now being carried on by the University of Nebraska Extension Division working with the United States Department of Agriculture at Mead, Nebraska. Here animals are being fed under controlled conditions with records being kept as to the size of the lot, the density of cattle, the type of soil, the slope of the land, and other natural features. The waste from these lots can be diverted into one of several different type of treatment and disposal systems, all, again, under good control. Already several ideas have been learned that will not work. By process of elimination, it is believed that a solution will be realized.

The greatest problem that confronts Nebraska Water Pollution Control Council is that of answering questions of persons intending to set up feedlot operations. They realize that control must be provided. They are asking what type of control should be installed in order that they can comply with the desires of the regulatory agency. This, at the present time, is difficult, because we have no guidelines for Nebraska conditions. We are hoping that through conferences such as these and the interchange of ideas among the several states that now already have controls that a reasonable, practical, effective control can be provided; and that we not only produce the best steaks in the country, but under conditions that are not detrimental to our environment, and especially the neighbors downstream from the feedlot operator raise no objection to this enterprise, and that the water that we are sending downstream will be desired by these users.

Inasmuch as need for water pollution control measures have brought new products into the forefront by their removal from the waste waters, I wonder if it might not be well to put on a big publicity campaign and create a fertilizer-humus-tilth-shud factory and sell the beef as a sideline. Whereby the feedlot operator could capitalize on phases of the industry and really make money.

Thank you.

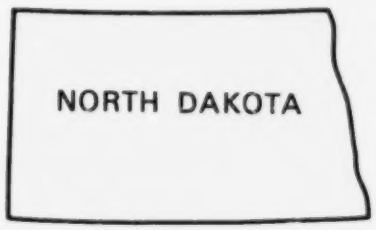
STATUS OF NORTH DAKOTA'S PROGRAM TO CONTROL POLLUTION FROM ANIMAL FEEDLOTS

Norman L. Peterson, Director
Division of Water Supply and Pollution Control
North Dakota State Department of Health

The North Dakota State Department of Health has been concerned with the growing problem of pollution from agricultural areas and primarily animal feedlots for the last few years. This concern was voiced to the State's new Water Pollution Control Board when they took office on July 1, 1967.

The Board requested the State Department of Health to present to them as much information on the problem as possible and, if possible, draft a proposed preliminary set of rules and regulations on how the State Health Department thought the problem should be covered. The Board was of the opinion that under the new State water pollution control statute that was enacted in 1967, creating the Board and empowering them to control pollution, that they did have all the necessary powers to control pollution from feedlots and agricultural areas, providing their requirements were reasonable and economically feasible.

The first draft of the proposed regulations was presented to the Board at their October, 1967, meeting. In the drafting of these rules and regulations, those which had been proposed for the State of Kansas were used as guidelines. The Board studied the rules and regulations, as proposed, and at their next meeting suggested a number of changes and, recognizing the seriousness of the matter and the problems that might be created, moved to set up an Advisory Committee on Feedlot Wastes. The President of the Board was asked to name the committee, to be composed of Health Department personnel, representatives of the Board, and representatives of the various cattle raising and feedlot operators associations active in the State. The Advisory Committee was to be asked to review and comment on the proposed regulations, take them back to their consitituents and discuss the matters with them, and to obtain as many comments on the proposals as possible. The Advisory Committee was also to be asked to make such recommended changes as they thought necessary.



At the first meeting of the Advisory Committee, after studying the proposed regulations, the Committee suggested some minor changes in the proposed regulations and a third draft of the rules and regulations was drawn up and sent to the Advisory Committee members.

At their next meeting, the Advisory Committee members reported that they had taken the third proposed draft of the rules and regulations to their various constituents but had been rather unsuccessful in obtaining too many comments.

This action and the findings of the Advisory Committee were reported to the State Water Pollution Control Board at their January, 1969, meeting. The Board was also informed of the Animal Wastes Management Conference which was to be held in Kansas City on February 20. The Board decided to withold any further action until they could get a report on the Kansas City meeting. This report will be provided them at their meeting.

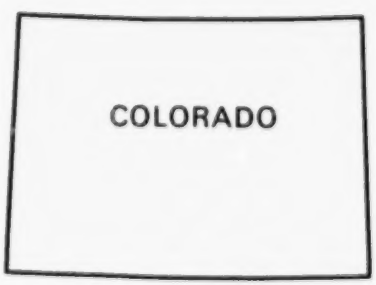
It is felt that there is need for much additional research into the problem of feedlot pollution. There are a number of factors that are difficult to determine, including the actual extent of pollution of these areas. As feedlots and their locations will differ, they do present a diverse problem to water pollution control agencies.

The State Department of Health and the State Water Pollution Control Board do plan to move ahead on this matter and to ultimately probably adopt rules and regulations to control pollution arising from feedlot operations.

COLORADO'S STATEMENT, STATUS, PLANS, AND NEEDS FOR A COMPREHENSIVE FEEDLOT POLLUTION CONTROL PROGRAM

Frank J. Rozich

As was pointed out during the panel discussion, there has not been a fish kill in Colorado which we could definitely attribute to feedlot wastes. However, this does not mean that we feel that feedlots are not contributing to the pollution of the waters of Colorado. The extent of this problem is being determined not only by the inventory that we are conducting, but also through stream studies being conducted through our surveillance program. We hope later to dispatch our trailer laboratory to the areas in question for more intensive stream studies.



After public hearings and much discussion pro and con, the Colorado Water Pollution Control Commission adopted *Rules For The Control Of Water Pollution From Livestock Confinement Facilities* on April 10, 1968. Where it is determined through our field inventory and subsequent inspection by our district engineer that a pollution problem does or can exist, the feeder will be asked to comply with the rules adopted by the Commission. If the feedlot operator fails to comply with the rules within a reasonable time, a Cease and Desist Order will be

issued and if necessary, an injunction will be sought through the courts of the State.

It should be pointed out that the rules that were adopted by the Commission include all types of animals that may be corralled and tethered or otherwise caused to remain in pens or corrals where feeding is of a type other than grazing on an open range. The reason I say this is that in Colorado, which is a recreational State, there are a number of horse corrals located adjacent to, or in some cases extending into, the streams of the State. We plan to deal with these in the same way that we will deal with cattle feeder operations.

We in Colorado are just beginning to look at the problem of feedlot pollution and we realize we will undoubtedly make a number of mistakes, not only in gathering an inventory of such facilities but also in our enforcement program. However, we do feel that we are advancing at a satisfactory pace which, of course, is greatly governed by the amount of monies and personnel available for such a project.

FEEDLOT POLLUTION CONTROL IN IOWA

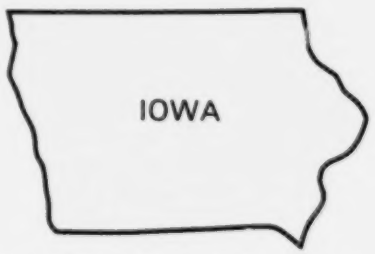
R. J. Schliekelman,
Director, Water Pollution Division
Environmental Engineering Service
Iowa State Department of Health

The State of Iowa with 46,000 beef feedlots is the largest cattle feeding state in the nation. At the same time we have experienced no serious pollution problems, such as the numerous fish kills in the State of Kansas, probably due to lesser concentrations.

The Iowa Water Pollution Control Commission realized that there is an increasing potential source of stream pollution in the runoff from sizeable farm feedlots. Currently there are approximately 135 farms feeding over 1,000 head of cattle and there have been some problems of feedlot runoff pollution. The increasing concentration of livestock on fewer farms and the resulting larger feeder operations will present additional waste disposal problems.

A study committee comprised of three Commission members, two agricultural engineers and the extension veterinarian from Iowa State University was formed in November 1966 to study the feedlot waste problem and make recommendations for corrective measures. An opinion was obtained from the Attorney General that there was adequate authority in the Iowa Water Pollution Control Law to correct existing pollution and that no additional legislation by the 1967 Legislature appeared necessary. The Committee advised the Commission that a permit system for large operations would be a desirable control measure and that rules and regulations be adopted by the Commission.

During 1967 a permanent Agricultural Advisory Committee was appointed by the Water Pollution Control Commission and given the task of formulating tentative criteria for a permit system and tentative standards for design of feedlot runoff control systems. Based upon the report of this advisory committee the Water Pollution Control Commission held four (4) public hearings in April, 1968 as a part of the procedure for establishing regulations to control feedlot waste disposal. The "Proposed Cattle Feedlot



Waste Water Disposal Regulations" defined a feedlot and described conditions under which a permit for waste disposal is required. Accompanying tentative "Requirements for Water Pollution Control Facilities" described satisfactory facilities for handling the feedlot runoff waste.

A number of minor changes were made in the proposed rules and regulations following comments at the public hearings. The principal objection at the hearings was to the requirement for a permit but there appeared to be less objection to registration. However, the Attorney General ruled that there was no legal basis for registration procedure in the Iowa Water Pollution Control Law and as a result the words "application for a permit" were retained in the regulation.

The rules and regulations were adopted by the Commission in 1968 and referred to the Legislative Departmental Rules Review Committee for final approval. Objections to the proposed rules were voiced by the Iowa Farm Bureau Federation and Iowa Beef Producers Association and the rules were disapproved after discussion at four meetings of the Committee. However, the Committee recommended and volunteered assistance in sponsoring legislation to permit a registration procedure.

It may be well to describe some pertinent features of the proposed feedlot waste water disposal regulations:

Definition: Feedlot for the purpose of water pollution control and regulation is defined as one or more adjacent or nearby cattle enclosures on a single property where there are at least 100 cattle where animal population is greater than 1 animal for each 600 square feet.

For example 50 cattle in a lot or 1000 head on a section of land does not meet the definition of a feedlot. We feel a certain cattle density is necessary to destroy the grass and permit runoff of concentrated wastes to a stream.

Conditions requiring (application for a permit) (registration). To operate a cattle feedlot (application for a permit for disposal of waste water) (registration) is required when one or more of the following conditions exist:

a. The number of cattle confined in a feedlot exceeds 1,000 head;
b. The feedlot contributes to a watercourse draining more than 3200 acres of land above the lot and the distance to the nearest point on the affected watercourse is less than 2 feet per head of cattle in the feedlot;
c. The runoff water from a feedlot or overflow from a lagoon or liquid manure storage tank flows into a tile line or other buried conduit, drainage well, pumped well, abandoned well or sinkhole.

We feel that the majority of the water pollution problems will originate in the feedlots confining more than 1000 head.

b. Applicants shall submit the completed application form to the department together with supplemental information regarding general features of topography, drainage course and identification of ultimate primary receiving streams. Additional information which may be deemed necessary for satisfactory evaluation of the application may be required by and shall be submitted to the department;

c. If the department determines that a proposed or existing cattle feedlot operation does not constitute a potential water pollution problem because of location, topography, or other reasons, provisions for water pollution control facilities will not be required;

d. If the department determines that a cattle feedlot does constitute

a water pollution potential, or if water pollution occurs as a result of any confined feeding operation, the operator shall provide water pollution control facilities which shall be constructed in accordance with plans and specifications approved by the department.

Requirements for facilities

a. The minimum water pollution control facilities for the confined feeding of cattle shall be terraces or retention ponds capable of containing three inches of surface runoff from the feedlot area, waste storage areas, and all other waste contributing areas. Diversion of surface drainage prior to contact with the confined feeding area or manure or sludge storage areas shall be required. Waste retained in detention ponds shall be disposed of as soon as practicable to insure adequate retention capacity for future needs;

The rules and regulations are considered to be a preventive measure to prevent pollution before it should occur. They will serve as a guideline to the developer of a new feeding operation in the location and construction of the feedlot and any necessary waste retention or handling facilities.

Legal action to abate pollution from livestock operations has been taken against five individuals or corporations and have involved as small an operation as 120 swine and as large an operation as 7000 feeder cattle. Numbers of animals are not a part of the law and pollution is abated wherever found.

Iowa State University's extension service has conducted short courses for cattle feeders and one of the main topics on the agenda has been preventing pollution from the feedlots. The staff for the Water Pollution Control Commission has counselled feeders on means of preventing pollution, inspected feedlots to recommend pollution prevention means on the site, and addressed public assemblies concerning the subject.

Soil Conservation Service agencies have been requested and encouraged to become involved in preventing pollution from livestock feeding operations by the Water Pollution Control Commissioners and Iowa Legislators. The need for preventing pollution has been presented to the Soil Conservation and Stabilization Service for their consideration.

Demonstration grants are needed and have been orally requested from the Federal Water Pollution Control Administration. Operation of model pollution prevention facilities serving the small and large livestock operations constructed in accord with all the recommendations of the Federal Water Pollution Control Administration would provide examples. Iowa feeders who want to prevent pollution or planning feedlot operations could inspect the model facilities, find the most economical method of preventing pollution and then build similar facilities on their own property. It is believed that these model facilities would do more than any other one item not already undertaken to prevent pollution from feedlots.

ANIMAL WASTE MANAGEMENT - QUESTIONS AND ANSWERS

Anthony V. Resnik, Sanitary Engineer
Missouri Basin Region, F.W.P.C.A.

The feeding of livestock in confinement has created a new major industry — one which has already become firmly established and continues to rapidly expand in the United States. This newly-emerged industry was developed to meet the demand for higher quality meat products with accompanying low production costs. Thus, in this busy highly competitive market place, little time or thought was given to those seemingly intangible benefits of water pollution control. During this emergent stage, feedlots were, by design, situated where the rains would scour the waste materials from the lots, preferably into nearby draws and streams.

With a short time lapse, we know now that the highly concentrated organic waste from feedlots cannot and must not be discharged without treatment into streams. It is clear that increased attention must be given to the control of feedlot runoff.

Tremendous strides have been made in the treatment of municipal wastes. However, comparable gains have not been achieved in the control and treatment of animal wastes. The difficulties encountered in controlling these wastes are emphasized in a report to the President of the United States dated January, 1969, submitted by the Secretary of Agriculture and the Director of the Office of Science and Technology, entitled "Control of Agriculture Related Pollution".

> "Water Quality Standards adopted by all 50 states and approved by the Secretary of the Interior include plans for implementation of interstate streams, lakes and coastal waters, with a few exceptions, these standards deal effectively with municipal and industrial wastes and their affect on water quality. However, with regard to agricultural waste in general, many difficulties have been encountered in developing appropriate and workable standards. Additional technical information is needed on the characteristics of runoff and on the effectiveness of the numerous treatment concepts being considered to implement the existing standard requirements."

We know that animal wastes are a major source of pollution in the Missouri River Basin. However, what is not known is the *exact* contribution and the *total* effect of animal wastes on the water quality of the basin. Norbert Winner, the father of modern information systems, once said: "To live effectively is to live with adequate information."

Some of the Missouri Basin States are in the process of quantifying the

animals on feed. This is a basic first step. However, it is equally important to correlate the animal numbers with terrain, water course and other factors to determine the effect of animal wastes on the water quality of the basin. This will require sampling and other surveillance techniques.

Traditionally, animal wastes have been considered as "natural" or "background" pollution. This is not unlike many other social institutions which become entrenched in the template of society . . . maintaining themselves as living relics in a rapidly changing world. We need, somehow, to achieve a fundamental change of belief . . . a whole new point of view toward the problem.

Prevention and control cannot wait while all the data are collected and assembled. Rather, increased control is imperative now. Feedlot runoff pollution could be greatly reduced with a minimum expenditure by utilizing known information. The majority of feedlot operations have not used those permanent techniques which minimize the quantity and strength of runoff waste. Thus, while diversion channels and dikes may be effectively used to minimize the quantity and strength of runoff waste, they may also be effectively used to keep the runoff from entering surface waters.

Regulations are, in effect, the blueprints for the animal waste control program. They act as a guide to planning, construction and enforcement. Controls cost money. Regulations are needed to ensure the feedlot operator that the measures he is taking will guarantee a reasonable tenure of operation. It is necessary that the operator know the controls being installed are adequate, and secondly, that frequent changes will not be sought by the official agency. Uniformity which concurrently allows for flexibility must be built into the regulation. Different requirements constitute an unfair economic barrier and are especially confusing to operators conducting business in two or more states.

The rallying cry grows louder for the development of a research model — a model to solve the complex animal waste problem. In reality, there is no *one* model or control device that will substantially alleviate animal waste pollution. There are many. Some are known, still others are yet to be developed.

Now I would like to pass on to this group some of the ideas that have been discussed in the hallways, at lunch and otherwise informally today. However, these ideas do not necessarily reflect the Federal Water Pollution Control Administration's position in animal waste control. The suggestions include:

> Zone entire watersheds for livestock production - with specified waste disposal areas.
>
> Federal and state governments supply monies to build "first generation" plants of new concept and design for the treatment and control of animal wastes.
>
> Develop better supplemental range feeding programs and equipment and extend the non-confinement period of the animals.
>
> Consider the possibility of combining manure with municipal garbage and composting such wastes for use on a "greenbelt", separating the city from the animals.

A possible solution, stated

one conference registrant, is to establish composting on a public utility basis rather than on a economic incentive basis.

I pass these on to you because technical skill, imagination and scientific innovation are necessary to solve this complex problem of animal waste pollution. And again I state that these ideas come from you people here today. It was also stated that much of the literature, to date, on animal waste pollution, has been pernicious in nature in that it has stressed the problems rather than the solutions. One gentleman from the West Coast stated that those who advocate waiting until all the facts are known should be afforded a soundproof laboratory to soliloquize. Thus, a kaleidoscope of ideas and solutions were discussed.

To date, it may well be that the goals of animal waste pollution control have been arrived at rather serendipitiously as previously suggested. However, positive steps are being taken. Increased emphasis will be given to solutions to the problem. This Conference has provided a forum for open, frank discussions. The discussions accompanied by action will solve the animal waste problem to the mutual satisfaction of those most concerned.

INVENTORY AND ASSESSMENT OF THE PROBLEM OF POLLUTION FROM FEEDLOT WASTES

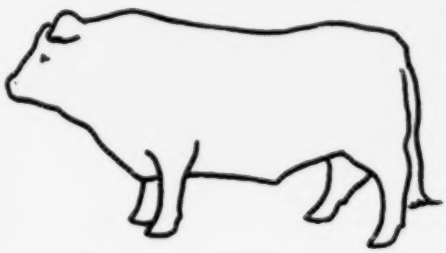
Norman L. Peterson

The problems of pollution from agriculture, and particularly from animal feedlots, presents a situation to State Water Pollution Control agencies that varies in many ways from those they are accustomed to dealing with. It was relatively simple to inventory wastes from municipalities and industries which are confined and usually have predictable flows. Feedlot wastes, on the other hand, generally reach the stream only during periods of runoff. It can be said they are confined only to the extent that drainage from most land areas will eventually channel into a natural drain to a stream. The flows are only as predictable as the weather and to this should be added such factors as soil characteristics and the topography of the feedlot area, number of cattle fed and features of the physical plant and its method of operation.

Nevertheless, it is accepted that wastes from feedlot operations can be a problem and the task of determining "how much," "where" and "when" and any solutions lie with the State or local water pollution control agencies.

Norbert Wiener, the father of modern information systems, once said, "To live effectively is to live with adequate information." A state water pollution control administrator might well add, "In order to determine the extent of pollution originating from feedlots and then effectively cope with the problem, it is also necessary to first obtain adequate information."

In some states, considerable information has already been gathered. Other states, and I'm including North Dakota with this group, are just getting started. We first sought to determine the areas of the State where most feedlots were concentrated and what major or minor river basins had the highest potential of being polluted at times from feedlot runoff. We were able to obtain a very broad picture of



Locate, Enumerate and Evaluate

these aspects from information already in our office, knowledge of personnel, information from district health unit personnel, Department of Agriculture publications, and some contacts with the County Agricultural Extension Service.

Our next step toward assessment of the problem is being directed toward developing an inventory. As is true with many state pollution control agencies, our budget is already strained and personnel limited. It will require some careful considerations and wise planning in order that this particular program can be worked in without disrupting too much the other phases of the State's water pollution control program. It must be assumed that there will be a considerable amount of personnel time and some travel involved in order to complete the inventory.

The information needed for the inventory should include for each feedlot its location, information on the area, the number of cattle handled, and characteristics of the lot operation and management.

There are a number of methods by which this information can be gathered. The State of Kansas, for one, requires permits. Nebraska requires registration. For such states, the operators could be required to submit this information in order to comply with the state's requirements. It has been suggested that the information be obtained through the State Agricultural Extension Service and their representatives in each county. In North Dakota, we had only limited success in our initial contacts but this source of information should not be overlooked. It is doubtful, however, if they could supply all the information the State agency would require. Another method which should certainly receive serious consideration from state pollution control agencies is direct contact with the various associations in the state that are involved. In North Dakota, this would be the North Dakota Cattle Feeders Association, the North Dakota Stockmen's Association, the State Milk Producers Association, the Farm Bureau, and the Farmers Union. The program would be voluntary on the part of the feedlot operators but it would be good public relations for both the industry and the state water pollution control agency. Agriculture, in general, is becoming increasingly aware of pollution and the problems arising from their operations. They are also becoming more concerned with the solutions. North Dakota has already taken a step toward such cooperation through the establishment of the Advisory Committee on Feedlot Wastes. Representatives of all the associations I previously mentioned are on this committee, together with State Health Department personnel and members of the North Dakota State Water Pollution Control Board.

It has been suggested that feedlots could be located by the use of airplanes or helicopters and that some data could be obtained from aerial photographs. This method has some advantages. It is a rapid means of locating feedlots and large areas can be covered as feedlots would be easily

sighted from the air. Aerial photos would be useful for the records as they would constitute an actual view of the feedlot areas. The disadvantage is that information on lot operation, numbers of cattle fed, and other such pertinent data are still lacking. Also, serious consideration should be given to the economic feasibility of this method before it is used.

It is questionable if the use of one or all of these methods will provide the State Water Pollution Control agency with all the information they might require for their inventory. There will probably be a number of instances where it will be necessary for their personnel to visit the site and obtain the needed information from the operator. Actually, personal contact with the operators can certainly pay dividends toward their acceptance of the program. It provides an opportunity for the State agency personnel to contact the operators individually, to discuss the aspects of pollution as it relates to his operation and to offer assistance and advice in planning control measures. Also, on-site evaluation of the area and the lot's operation must certainly be considered one of the better means of assessing pollution problems.

Each state water pollution control agency must decide on the data that they believe are needed to satisfactorily assess the problem in their state. I suggest the following data should be gathered:

1. Location of the feedlot: This can be done by geographic, political, legal description, hydrographic, or by other means. As potential pollution sources could affect water quality standards, the river basin should be identified.
2. Information on the facility: This should include the topography of the lot and the surrounding area, general soil characteristics, if possible. The area of the lot and its relation to the surrounding area. Is housing or shelter provided and is the lot area paved?
3. Information on lot operation: The number of cattle handled and any seasonal variations in these numbers. The practice used for manure disposal and where is the disposal made. If the lot is paved, how much water is used for washing down the area.

A state water pollution control agency, adding pertinent weather data to this information, should be in position to assess the pollution potential from each of the individual feedlots and the total potential for each river basin. Certainly it would not be surprising to find that there will be a variance. Some larger lots may not present a real problem while a particular smaller one might be a serious source of pollution.

It would seem that much can be accomplished if the state water pollution control agency would consider itself more than just a regulatory agency. Certainly much can be accomplished toward beneficial cooperation and good will through a sincere offer of assistance and advice to individual feedlot operators. The North Dakota State Water Pollution Control Board is presently considering adoption of rules and regulations covering the problem. These will not be used indiscriminately. They are drawn up for the purpose of assisting the State agency and the feedlot operator to solve a mutual problem.

ASSESSING THE PROBLEM OF FEEDLOT POLLUTION

Dr. Coy G. McNabb, Extension Economist
Professor of Agricultural Economics
University of Missouri - Columbia

During the past few years pollution from feedlots has received increasing public attention, partly because of the growing number and increasing size of such feedlots, partly because they can be seen and smelled, and partly because an affluent society is becoming more concerned about esthetic values. The amount of interest and concern is exceeded only by the apparent lack of data that fully define the extent of the problem by geographic areas. But action is demanded. We must move ahead using the best information available and at the same time trying to secure the additional data needed.

Some would argue, quite validly, that before we move very far, or set priorities, we need to know the magnitude of the feedlot problem as related to the total pollution problem. But the fact remains that efforts should and probably will be made to work on all pollution problems, even scattered ones when and where they exist. These efforts will decrease pollution a little here and a little there, with the end result being a significant decrease. That's about where we are now. The big question is, where do we go from here?

Let's start with what we need to know to get the problem in proper perspective. A partial listing of the types of data that would be useful in assessing the feedlot problem include: how many and what size, how many have impoundments to catch runoff, how the solid and liquid wastes are handled, the slope and length of slope where located, and the types of soil, (open gravelly or tight clay).

In Missouri we do not have these data. We would not actually know the magnitude of the problem if we had them, but we would know much more than we know now. We could identify, in a more accurate manner, those drainage areas having the greatest potential for pollution from feedlots.

What we really need to know is the effect of feedlots on the water quality of a basin. Are there consequences attributable to feedlots that make it important to single out this source as the place to set top priority for pollution abatement programs. To say it another way, are natural events such as the runoff from pasture, timber, cropland or the entire terrain of much greater significance than the feedlots in a given basin?

These are not new questions to the people who have been working on pollution control programs. I know that the Missouri Water Pollution Board is working to get additional data through its quality surveys by basin. These data should be very helpful.

In trying to develop a useful and reliable inventory, it seems to me there are two alternatives open to us in Missouri. One is to take the route of legislation - try to get a state statute on the books requiring permits for all operators who confine and feed a certain number of animals. Kansas has legislation requiring permits. Obviously all kinds of data can be collected in the process of obtaining the permit. The task of identifying problems and eliminating them falls rather neatly in the hands of the regulatory agency.

But what about states that do not have such legislation? Missouri falls in that category. In such states, how can the inventory be taken, the extent and nature of the problem identified and a pollution abatement program started immediately? That brings us to the second alternative and it will have to be examined closely to determine if it has merit.

Can pollution control officials and agricultural agencies go direct to the livestock groups, lay out the problem, and get their cooperation in inventorying the problem and adopting pollution control practices? Some Missouri feeders have already voluntarily constructed retention basins aimed at preventing organic wastes from entering a stream.

Is it logical to assume that livestock

feeders are interested in policing their own group, in helping set the guidelines to be used in a pollution abatement program, in helping determine effective regulations or restrictions to be imposed?

In recent weeks I have been impressed with the interest and attitude of leaders of livestock organizations toward the pollution problem associated with concentration of animals in feedlots. It is apparent that many are willing to take the steps necessary to construct pollution abatement facilities and to encourage members of their organization to do so. Their biggest question right now is what needs to be done? More than a little uncertainty exists on the type of pollution abatement facilities that are effective and feasible.

More research, study and new innovation by producers will be required to get the answer here. I am happy to report that these kinds of activities are underway and increasing in number. Even if we don't know all the answers about proper and practical methods to handle feedlot wastes, we know much about what not to do. So this gives us a place to start.

How effective will an educational and voluntary effort of this kind be in reaching the goals established for pollution control? I don't know. Not all producers or feeders are members of organized livestock groups. It is also true that these voluntary organizations do not have tight control over their membership. But I would hasten to point out that millions of acres have been treated with soil conservation practices without statutory requirements. You might reply that there are many more acres to be treated. But, the real question is do we have more conservation using the nonmandatory approach than we would have had with a compulsory requirement? The answer can only be speculative but I am sure that livestock feeders are ready to accept a voluntary educational program long before mandatory regulations are politically feasible. The big question is whether livestock feeders will move fast enough.

Any law to be effective and accomplish its goal must have the support of a majority of the people. For example, Missouri enacted an automobile inspection law last year to be effective January 1, 1969. The idea sounded good but enforcement has caused widespread dissatisfaction and the people are letting the lawmakers hear about it. Presently, several approaches to resolve the problem are being considered by the General Assembly, all the way from repealing the law to revising the standards.

A lot of education needs to be done about pollution problems and feedlots. The first step is to create more awareness of the problem on the part of the livestock people themselves. This virtually means a change in our culture and this kind of change comes slow. On the farm and elsewhere we have grown up with the concept that the way to get rid of unwanted substances, whether liquid or solid is to put them in a ditch or stream and let the rains take them away. For some years now hog feeders have built lagoons but the overriding purpose has been to get rid of the waste rather than control pollution. Pollution control usually was only a secondary objective. A change in our way of thinking becomes necessary and this is brought about through effective educational programs.

We have begun an educational effort in Missouri in cooperation with our State Water Pollution Board. Two steps that have been taken recently include (1) a seminar with researchers in the Experiment Station and (2) a meeting with agricultural organizations.

The seminar with research faculty and state water pollution officials was held last spring. This was to bring together in one publication the latest information about all agricultural related pollution problems. A major consequence was to increase awareness on the part of agricultural researchers that pollution is here with us now.

The second activity, and of more significance here, was the recent meeting with about 20 officials representing livestock associations, general farm organizations, fertilizer and pesticide organizations. This group met to discuss the problem and discuss what each organization and the Missouri College of Agriculture could and should be doing about it. From the comments of those attending, it was evident that the majority felt an educational effort should be made. I am sure this increased awareness will cause initiation of a lot of voluntary abatement programs and more producers will be willing to cooperate by providing information. In addition, they will see the need for an overall effort on the part of the livestock industry.

It's a relatively simple but time consuming task to estimate the potential for pollution from agriculture by basin or watershed, provided you can get the county data. I have done this for Missouri at the request of the Water Pollution Board. This information is now available from them. The study compiled data on 53 basins. It included: (1) each basin's potential for erosion (2) the amount of fertilizer applied (3) the insecticides used in corn production (4) herbicides applied to soybeans and (5) the concentration of cattle and cattle feedlots, swine and poultry.

We determined the number of cattle feedlots by drainage basin. For example, we know that the Tarkio River basin has 33 cattle feedlots, feeding 100 head or more annually. The Little Osage basin, which is slightly larger in size, has only 8. Other basins have none even though they may have a much larger land area. But we do not know whether the feedlots in any basin, either individually or collectively, are a significant source of pollution. This is what we need to know. These data do tell us that the potential is greater in some watersheds than others. This is the logical place to start to quantify the problem.

I recommend that when a agency starts a water quality survey, it work closely with agricultural interests. The feedlot operators and the agricultural agencies need to have the facts straight from the agency doing the survey. Tell them what you plan to do. Above all, tell them why. Show them that it isn't some government agency wanting to run roughshod over them and put them out of business. The best way to avoid rumor is to get the facts "straight from the horse's mouth". Some government agencies have the reputation of exercising their powers to the detriment of the individual who is powerless to do anything about it. I am sure this reputation is the result of the action and attitude of a relatively few individuals in government service. I am equally sure that in Missouri we do not have this type of officials in the Water Pollution Board.

The big question about pollution in general and feedlot pollution in particular is whether an education and voluntary effort will be fast enough to meet the goals already established, and effective enough to get the job done in the long run.

Now let me summarize. Earlier I said that there were two alternatives to Missouri and states in a similar position. I suggested that one could be the route of legislation; the other is based on information and education. Actually, I may have given you a false dichotomy. It is not one or the other. Regardless of the route taken, legislation or not, it will be necessary to move aggressively on an information-education program to bring about the change in attitude that is required. I don't see how you can lose by working directly with the agricultural interest involved, informing and involving them in the decision making as much as possible. If this is not enough to complete the task, then legislation will follow. In the meantime, you have gained widespread support from the public and from a surprising number of agricultural leaders as well.

A RECOMMENDED PROCEDURE FOR DEVELOPING A MODEL FEEDLOT REGULATION

Floyd L. Matthew
Associate Professor
South Dakota School of Mines and Technology

Most state water pollution control agencies are either developing, approving or implementing a new regulation to control pollution from feedlots.

In reviewing existing or proposed state regulations to control pollution from feedlots one finds a wide divergence in style, scope, definitions and content. As long as the objective - to control pollution from feedlots - is met, this divergence is not a serious problem. However, feedlot operators carrying on business in two or more states find different requirements confusing and this normally leads to less cooperation. More uniform regulations also simplify cooperative control programs between states and with the Federal Government. Many other arguments can be presented to justify an attempt to produce more uniformity in feedlot regulations.

The Missouri Basin Region of the Federal Water Pollution Control Administration has proposed that a committee on feedlot regulations be formed to develop a model regulation that would serve as a guide for state water pollution control agencies. The objective of this paper is to present a recommended plan of action for such a committee. The plan is approached from the standpoint of a state water pollution agency which desires to develop and implement a feedlot control program. The committee working on a model regulation should think in state-level terms since the state agencies will be using the model regulation.

General Considerations

Before embarking on a feedlot control program, a state should first establish the *need* for a feedlot regulation. Feedlot wastes are, in reality, industrial wastes and existing statutes and regulations covering industrial wastes may adequately form a base for a feedlot pollution control program. Information already accumulated and assembled by other departments, such as the livestock sanitary board or the Department of Agriculture, may be adequate for inventory purposes which would eliminate the need for registration by the pollution control agency. Permit requirements outlined in the existing laws and regulations may apply to feedlot wastes without requiring any changes.

Should the initial study indicate a need for a regulation, the state water pollution control agency should clearly define the objectives of the proposed regulation and determine precisely what the regulation should do and how the regulation will be implemented.

With the need established, and objectives clearly in mind, the water pollution control agency should proceed with an information and education campaign. Feedlot operators are, generally, an independent group who are opposed to governmental regulation. Feeding is a risky business and overhead costs are very important to

any successful feedlot operation. For this reason, any feedlot regulation should be developed cooperatively with feeder organizations, if at all possible, and the affected operators should be kept informed of the status and format of the proposed regulation. In reality, no feedlot regulation will be effective without the cooperation of feeders because there are too many small units to control through enforcement action alone. Very few state water pollution control agencies can support such a legal enforcement program.

A feedlot regulation should be sold as being good for *agriculture*. It *is* good for agriculture. Good quality water is agriculture's life blood and without pollution control, agriculture could well choke to death on her own wastes. It isn't difficult to sell agribusinessmen on the need for water pollution control, but they *must* be informed.

Regulation Objectives

After the need for a feedlot regulation has been established, the general and specific objectives of the regulation should be clearly defined. The general objective of a feedlot water pollution control regulation is, simply, to minimize or eliminate water pollution from feedlots. The specific objectives of any feedlot regulation should include:

1. Establish the scope of the control program and clearly define who is affected and whether both ground and surface waters are included.
2. Define all technical and legal terms.
3. List parameters considered to be pollutants.
4. Clearly state how the regulation relates to existing laws, regulations and stream standards.
5. Stipulate registration, permit application, fee payment, approval and appeal procedures.
6. Outline minimum construction and operation requirements.
7. Establish minimum effluent quality standards for all important pollution parameters.
8. Specify legal violation (misdemeanor . . .) and punishment for violators.

Restraints

The next step in developing the feedlot regulation is to consider restraints that will form the framework within which the regulation must be developed, accepted and implemented.

Budget and staff limitations will affect the implementation of feedlot regulations in most states. Consequently, the regulation requirements should be established with these limitations in mind. A proposed regulation should not be presented to the public until the implementation program plans have been completed.

Political restraints should be established as nearly as possible. This will help in developing the information and public education program before and during the regulation adoption proceedings. Consideration of political restraints during the preparation of the regulation can often result in wording and requirement presentations that minimize opposition during adoption hearings while, at the same time, producing essentially the same control.

Legal restraints should be established. What authority does the pollution control agency have in this area? Are existing authorities of other departments being duplicated or breached? How will the proposed program mesh with existing and proposed programs on the Federal, State and

local level? These and other legal questions should be answered before developing a regulation.

One of the most perplexing restraints is that of technical insufficiency. Not enough is known of animal waste pollutants and their effects on water uses. Our technical knowledge of animal waste treatment systems is inadequate to predict efficiencies or effluent quality with any degree of reliability. Knowledge of the raw waste characteristics is accumulating rapidly, but is still inadequate. These problems must be considered when developing the regulations. Every effort should be made to incorporate the results of the most recent research when specifying treatment and effluent requirements.

Evaluation

A feedlot regulation must satisfy several requirements. Evaluation criteria should include:

1. Is the regulation preventive or corrective in nature? The objective, of course, is to prevent water pollution if at all possible.

2. Does the regulation clearly inform the feedlot operator of his obligations? The operator's responsibility for registering, applying for permits, submitting operation reports, self monitoring, etc. should be clearly stated and deadlines, application dates, renewal requirements, etc., should be provided.

3. Is the regulation enforceable within current or proposed staffing and budget restraints? The implementation program should be developed concurrently with the regulation.

4. Does the regulation contain provisions for appeal?

5. Does the regulation avoid discrimination? Unless the regulation is non-discriminatory it will not normally hold up in court.

6. Does the regulation provide for control of both new and existing operations?

7. Does the regulation provide for control of construction *and* operation?

8. Are provisions included covering ultimate disposal of wastes removed or discharged from holding or treatment units?

9. Does the regulation provide for periodic updating so new treatment methods and research results can be incorporated easily and efficiently?

10. Is the regulation compatible with existing Federal, state and local laws, statutes, regulations or ordinances?

11. Is pollution defined and are pollution parameters enumerated?

12. Does the regulation establish effluent quality standards? If it does, are concentration-duration values specified and sampling procedures outlined?

Summary

In the development of a feedlot regulation, other alternatives should first be considered and the need for a regulation firmly established. Next, it is necessary to establish general and specific objectives for the proposed regulation.

After establishing objectives, restraints should be considered. Budget and staff limitations will normally be the most important restraints on the implementation program.

The last step is to establish evaluation criteria.

When these steps have been taken and necessary public information programs are underway, the development of the feedlot regulation and implementation program plans can proceed. The committee chosen to develop a model regulation should attempt to provide a reference which will help guide Missouri Basin state water pollution agencies under conditions existing in these states.

RESEARCH NEEDS IN CATTLE FEEDLOT WASTE CONTROL

Dr. Lawrence A. Schmid, Assistant Professor of Civil Engineering
Kansas State University, Manhattan, Kansas

In considering research needs in feedlot pollution control, one must consider what has been and is being done. This immediately raises a problem that we have in this new field of research and that is the dissemination of research information. Research in this area of commercial feedlot waste management is being supported by several different Federal agencies, the state Water Pollution Control agencies, and some industry with the research being conducted by educational institutions, private research groups, and the industry itself. We can see very easily that communication among the groups will probably not be the best.

A vast amount of information will be collected but there is no easy way to determine what and where this information is available. More important yet is how can we get this information to the people that must use it; the feedlot operators, the engineers, and the regulatory agencies?

We need then a procedure to assemble this information and to present it to the people that must use it. I feel that one solution would be to hold conferences or workshops on a regional basis where these groups would be invited to participate. A committee could have the responsibility for determining the active and completed research applicable to the problems of the region and could either report on this directly or have a report from the research representatives. Solutions to the feedlot problem should be presented with direct emphasis on application, with feedback from the industry as to preferred methods, practices, and other problems of implementation. This can also give direction to further research.

I am certain that the present lack of communication leads to some duplication of effort but I want to emphasize that duplication of effort in research is not all bad. Climatic, nutritional, and physical variables will require that the work be done at several diverse locations. This same type of data collected under varying conditions can help to tie various other aspects of the research together which can lead to a more reliable extrapolation of the data.

Research Priorities

Research priorities cannot be separated completely as one, two, and three, for most of the categories are interrelated. However, I will attempt to define research areas and to explain why or why not we should increase our research effort in these areas.

I would place characterization of the wastes in a category that should receive increased research emphasis. I

am not saying that this should be the prime objective of any study but it should be included wherever possible. Besides the runoff, the solid wastes, the manure removed from the lots, should also be included in characterization for the method used for handling and disposing of this material can have a significant impact on reducing overall pollution from the facility.

Only by having a more reliable method of predicting the characteristics of the waste under varying conditions can we better select the disposal method to use. Characterization data obtained at one lot can not be extrapolated to all other conditions but characterization data from many lots increases this reliability.

The sanitary engineer's fundamental knowledge of biological waste treatment and other processes is sufficient that he can design a process, biological or otherwise, based on a knowledge of the waste characteristics. This can be done with a good degree of success with prediction of both the effluent quality and the costs involved. Research on the application of these processes to liquid systems does not warrant, in my opinion, a high priority.

Biological treatment in a liquid system of the manure removed from a feedlot should not warrant a high degree of priority. These solids may be removed from the lot at 50 percent moisture or less. Approximately 10 to 30 percent of the dry solids may be biodegradable, depending on the length of time the manure remained on the lot. Putting this into a liquid system to stabilize the organic matter will result in no reduction in inert solids and some production of biological solids during stabilization. Assuming that 30 percent of the solids could be biodegradable and taking into account the biological solids produced during stabilization it appears that the most we could hope for is about a 20 percent reduction in the solids that we must handle. These solids must then be removed from the liquid system, and returned to 80 percent or less moisture for ultimate disposal. This I advocate is a very inefficient solids handling procedure.

If the purpose of adding the lot manure to the liquid system is for BOD removal I put forth the same argument. Why add organic matter that is in a semi-solid state to a liquid system, only to have to remove a portion of this organic matter as biological solids? It is very probable that the treated effluent will result in a BOD higher than the untreated runoff water.

Composting of the lot manure is another form of biological treatment and as such we could expect about the same solids destruction as in the liquid system, a maximum of 20 percent. Composting has the advantage of destroying disease producing organisms and producing a humus, relatively odor free end product. However the moisture must be maintained between 50 and 60 percent and the mass must be kept aerobic. Composting just for the purpose of spreading on adjacent land would serve no beneficial purpose. Sale of the product as a soil conditioner or fertilizer would probably be the main objective of composting. Experience in the U.S. has indicated a very small market for composted material or digested and processed sewage sludges. The cheapness of chemical fertilizers and their ease of handling reduces the attractiveness of compost. It is doubtful that any significant market could be developed to absorb the tremendous quantities of compost that could be produced from cattle feeding operations.

It appears then that some other form of treatment or disposal must be more logical and economical. Return to the land appears to be the most favored alternative at this time. This can be a return of both feedlot runoff and the manure removed from the lots.

This method may appear old fashioned and lack the sophistication which we are used to in our modern society, but when you analyze the alternatives you keep coming up with the same question, Why not put it back on the land? This brings me to my second priority for research, land disposal. Although we have been doing this for years we have not been doing it at the loadings anticipated from a large production feedlot operation and as such we know very little of the effect that it can have on the environment.

The following are some of the questions that are asked and must be answered. What happens when we return this material to the land? What land area do we need for disposal? When we apply the lagoon effluent and solid manure to a small area are we going to run the risk of ground water pollution due to salts, nitrates, pathogenic organisms, or other substances yet unknown? Nitrates we realize are a problem when they enter water that may be used for domestic or animal consumption. Can we design a soil disposal procedure that will allow for nitrification followed by denitrification which results in the loss of nitrogen gas to the atmosphere? Should we use a cover crop to remove nutrients and if so what are the best management practices to follow? If extensive irrigation is practiced can we keep the nitrates or other pollutants in the zone of influence of the irrigation wells so that they can be returned to the surface to be taken up by the crops? If we dispose of the manure onto the land, will heavy applications cause runoff problems similar to that occurring from the feedlots?

The agronomists have evidence which indicates that heavy application of these wastes, which are high in salts, to the soil may result in soil dispersion which greatly decreases soil water intake. This is harmful not only to plant production but also reduces the capacity of the soil to receive further treatment of wastes. Somewhere there must be a balance between the rate of waste disposal, land destruction, and crop production while satisfying the primary goal; water pollution control, of both the surface and ground waters.

The next area of priority deals with either management practices or processes to reduce the solid or liquid waste that comes from the lot. Along the same line would be practices or processes to reduce the material for ultimate disposal. One process that would greatly reduce the amount of material for ultimate disposal would be incineration. Landfill of the lot material might also be an acceptable alternative which would result in retiring the land from use for some time. What this length of time may be and the effect on groundwater may be subjects of research.

The last priority that I list for research is one I have already mentioned and that is liquid waste treatment systems. I see this however only for the liquid runoff material and I will discuss it under those conditions. We have three basic methods of treating liquid wastes, physical, chemical, biological, or a system combining any of these. If we plan on discharging the treated effluent to a watercourse the biological process appears to be the most favorable. Feedlot runoff can have a BOD in mg/l in the thousands. To produce an effluent comparable to that of secondary treatment of domestic sewage may require 99 % removal of the BOD. This is not impossible with biological treatment of high strength wastes but it can be difficult and expensive.

Other areas of research that may require attention are changes in feeding practices to reduce wastes, reuse of wastes as feed material, or other by-product recovery schemes.

I feel that we already have some of the short term answers to the problem but most of the research areas outlined here point to the question that we must keep asking ourselves; What are the long term solutions of feedlot waste management?

DEVELOPING AN ANIMAL WASTE MANAGEMENT ACTION PROGRAM

Dr. Schell H. Bodenhamer, Associate Dean
College of Agriculture of Extension
University of Missouri

Many dynamic forces will affect the implementation of a desired animal waste management program. Here is an outline of some of the factors that should be considered.

Any social system (i.e., agency, organizational, special interest group) before attempting to initiate change should:

1. Specifically
   a. Define the situation to be changed.
   b. Describe the desired, feasible situation.
   c. List what needs to be done to close the *gap* between the present and desired situation.
   d. Describe the resources available and needed.
2. Define and write the *message* (desired action) that will be beamed or transmitted to the specific audience that is to effect the change.
3. List the *audience(s)* that can have the greatest impact on changing the specific situation.
   a. National
   b. State
   c. Watershed
   d. County
   e. Individual
   f. Etc.
4. Decide on the *channel (s)* or the way the message is to be sent to reach the audience. The *channel(s)* used will be influenced by:
   a. Whether it is a mass, group or individual audience.
   b. The state of adoption of the audience - (1) Awareness, (2) Interest, (3) Evaluation, (4) Trial, or (5) Adoption.

Remember, that for change to be brought about most effectively and efficiently, *each* audience will need to see how the change will help them satisfy their *own* needs for goods, services and attitudes.

Change is best brought about through good communications and cooperation. For communications to be most effective, there should be a sharing of ideas in a mood of mutualities.

Those to affect or be affected by animal waste management programs must be involved in deciding what should be the program. Cooperation is positively correlated with the degree of involvement the parties to be affected are involved in shaping the proposed action. Remember, it is difficult to order someone to cooperate.

In keeping with the thought "to organize one's mind is to control it," it is hoped this outline will be helpful in developing action programs.

RESEARCH AND DEVELOPMENT VIEWS OF ANIMAL WASTE MANAGEMENT

Hal Bernard, Chief,
Agricultural and Marine Pollution Control Branch
Division of Applied Science and Technology
Federal Water Pollution Control Administration

Let me refer to your expression of interest to participate in a practical program of Animal Waste Management, and let me indicate that this is an area that I also am extremely interested in. I have been given the responsibility by the Water Pollution Control Office of Research and Development to develop a practical arsenal of management and treatment concepts that can be utilized by your industry.

Permit me to add a couple of statements to try and put this in a perspective that is within the national pollution abatement program. Today, several times I have heard mentioned the possibility that our emphasis on the need for pollution abatement for the animal feeding industry is attuned to a goading the industry to do something about it yesterday. This is true to some extent, that is to the extent that you must consider, as is being done by the remainder of your industrial community, the additional requirements for abating pollution for animal feeding.

Other parts of our national production capacity are being tapped for 8 to 50 billion dollars over the next 10 years, depending upon the degree of treatment you consider is necessary. Let me indicate that this particularly large investment will only buy us some time. Just by virtue of the population expansion, we expect that by 1985 the downward trend in pollution abatement will reverse itself, so that by the turn of the century, we will be as bad off as we are today unless we apply even greater pollution removal techniques.

Let me suggest that we all must consider the problem of the waste from animal feeding, not only as a pollution abatement problem, but rather as an animal feeding or an animal management problem in which waste management is considered as an integral part of the overall problem of making a profit from your investment, either for yourself or for your stockholders. From this standpoint your prime consideration is to maximize profit taking into consideration the additional cost associated with waste management. This could even mean changing the feed to decrease the amount of wastes produced or the quality to make it easier to handle the waste products. As a profit making organization this has to become a part of your operation.

Let me just reiterate once more that the nation as a whole desires pollution abatement to become an integral part of our economy and expects a definite improvement in our environment.

The Office of Research and Development is anxious to demonstrate new or improved techniques for handling and treating animal wastes that reduce the pollutional load to receiving streams or ground water. We can participate with industry up to 70% of the total cost of such projects. Mr. Rademacher's office can supply the details on how we both may participate to our mutual advantage.

THOMAS HART BENTON, the artist featured on the cover, is a man who sees America with an honesty not given to many men and who loves America with an intensity exceeded by no one. He is an outspoken realist, as well as a critic and a defender of his country. He has been roaming and painting her cities, mountains, fields and rivers for three quarters of a century. He is a great artist who still paints (some say more beautifully than ever) at the age of 80 in his Kansas City, Missouri studio.